SCIENCE

VOL. 90 FRIDAY, SEPTEMBER 1, 1939 No. 2331

The British Association for the Advancement of Science:
The Western Isles through the Mists of Ages: SIR ALBERT SEWARD 189

Scientific Events:
The Forests of Great Britain; The Australian Meteorite in the Collection of the Smithsonian Institution; The Proposed Inter-American University in Puerto Rico; The New York Meeting of the Electrochemical Society; Lectures at the Dundee Meeting of the British Association. Recent Deaths and Memorials 200

Scientific Notes and News 203

Discussion:
Conditions and Opportunities at the Naples Zoological Station: DR. R. E. COKER. *One-Man Authority Citations:* DR. CORNELIUS H. MULLER. *Spraying with Plant Growth Substances to Prevent Apple Fruit Dropping:* DR. F. E. GARDNER, P. C. MARTH and DR. L. P. BATJER. *"Distinction" in "Science":* DR. C. STUART GAGER 206

Special Correspondence:
Research in Venezuela: DR. GEORGE GAYLORD SIMPSON 210

Scientific Books:
Malaria in Panama: PROFESSOR W. H. TALIAFERRO 211

Societies and Meetings:
The North Carolina Academy of Science: PROFESSOR H. L. BLOMQUIST 212

Special Articles:
Chemical Composition of the Tumor-producing Fraction of Chicken Tumor I: DR. ALBERT CLAUDE. *Vitamin K Activity of Synthetic Phthiocol:* DR. ERHARD FERNHOLZ and DR. S. ANSBACHER. *Human Vaccination against Equine Encephalomyelitis Virus with Formolized Chick Embryo Vaccine:* DR. J. W. BEARD, DOROTHY BEARD and HAROLD FINKELSTEIN 213

Science News 10

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

THE WESTERN ISLES THROUGH THE MISTS OF AGES[1]

By Sir ALBERT SEWARD

PROFESSOR OF BOTANY EMERITUS OF THE UNIVERSITY OF CAMBRIDGE

INTRODUCTORY

TWENTY-SEVEN years ago, when the British Association met for the second time in Dundee, Sir Edward Schäfer chose as the subject of his presidential address "The Nature, Origin and Maintenance of Life"; he discussed problems that will long continue to exercise the ingenuity and stimulate the imagination of biologists and chemists. A theme such as his is far beyond my reach. Seventy-two years ago the association met for the first time in this city. The Duke of Buccleuch occupied the presidential chair, and the opening words of his address are applicable to one who now finds himself in this privileged position; the Duke said: "No man has a title to state that he is unworthy of the post he is called on to fill, whatever may be his private feelings as to his fitness for the post. To state that he is unworthy to be there placed is not only a disparagement to himself, but is no great compliment to those who thought him worthy of being so placed."

This, in my opinion, is not an occasion on which it is desirable to follow the easier course and address oneself in technical language to fellow workers in the pursuit of natural knowledge. The position which it is my great privilege to occupy affords a rare opportunity of talking to a large and, I venture to hope, a sympathetic audience, including some at least who are repelled by the jargon of specialists. My intention is to speak in ordinary language on a subject of which I know enough to realize how little that knowledge is, and briefly to describe an example of the way in which, within one small patch of an illimitable field, a student asks questions of nature and does his best to interpret the answers.

[1] Address of the president of the British Association for the Advancement of Science, Dundee meeting, August 30, 1939.

AN EXCURSION INTO THE PAST

I invite my audience to accompany me on an excursion of a kind which has substantially contributed to the enjoyment and enrichment of my own life, an excursion into a world that knew not man, with the object of deciphering from such records as we find in the rocks a few pages of the story-book of the earth. Each one of us can say with Shakespeare's soothsayer:

> In Nature's infinite book of secrecy
> A little I can read.

As that great Scotsman, Hugh Miller, wrote nearly a century ago: "We find the present incomplete without the past—the recent without the extinct." To reinforce his own opinion he quoted Samuel Johnson: "Whatever makes the past, the distant, or the future predominate over the present, advances us in the dignity of thinking beings." We shall try to reconstruct a small part of an ancient land, a remnant of which is now called Scotland, and envisage a scene at a stage in the history of the earth separated from the present by at least sixty million years, a stretch of time difficult for us who have been called "the afterthoughts of creation" fully to appreciate. When we substitute geological standards for the modest time-scale of the human period and remember that the earliest chapters of the world's history are recorded in rocks at least two thousand million years old, sixty million years dwindle to comparative insignificance. All that it is possible to do is to lift a corner of the veil separating us from the world as it was and view through dimly illuminated vistas the forests and undergrowth on an ancient continent that is now represented by a few widely scattered, dismembered pieces.

THE HISTORY OF PLANT LIFE

The history of plant life in the sea and on land is a branch of natural knowledge not unworthy of consideration by us human beings who owe our existence to the vegetable kingdom. Green plants in one vital sense are our superiors: from air and water they build up the complex organic substances necessary to our life, a feat beyond man's power. As members of a subject race we should be interested in endeavoring to unravel the history of the plant kingdom—in trying to trace the origin and relations of the several classes and groups as defined by botanists. The documents that are the sources of the botanical historian are contained in the earth's crust: as a preliminary it is worth while to ask ourselves of what these documents consist; how they came to be preserved in the rocks. In order to bring to life the past we must take the present for our guide. "Speak to the earth, and it shall teach thee." There is no reason to think of nature's methods as other than continuous. If we stand by the bank of a river flowing past tree-covered slopes we see on the sand and mud by the edge of the channel or floating on the stream leaves, twigs and seeds that are random samples of vegetation scattered by wind or shed from overhanging boughs, debris swept along with offscourings from the rocks to be carried eventually to a delta or an estuary where the water-borne material comes to rest. Beds of old sands and mud, with included fragments of contemporary trees and other plants, exposed on the faces of cliffs and ravines, are layers of sediment that have been raised to a higher level. In addition to leaves, twigs and other scraps easy to see on the split surface of sandstone or shale, sediments of former ages, especially such as are peaty, occasionally furnish another valuable source of information invisible to the unaided eye. Minute grains of pollen may be carried by wind to places where conditions are favorable for their preservation: fortunately the grains or at least most of them, are protected by highly resistant coats and retain almost for all time their characteristic form and surface sculpturing. With hardly any exception it is possible for a specialist, by comparative microscopical examination of fresh material, to assign fossil pollen-grains to their generic and occasionally their specific position in the plant kingdom.

There is another natural agency to which students of extinct plants are not infrequently indebted: the formation of rocks by volcanic action. From time to time volcanoes that have long been dormant eject clouds of ash; these with streams of lava poured over the rim of a crater spread havoc among trees and shrubs that had colonized precarious sites during a peaceful interlude. Vulcanicity is not only destructive: paradoxical as it may seem, forces inimical to life have contributed to the reconstruction of life which they destroyed. Scotland is exceptionally rich in botanical treasures that are legacies from ages of fire, and indeed the fossil plants with which we are concerned this evening owe their preservation to volcanic forces.

The following botanical retrospect is based mainly on results obtained during the last two or three years, but not yet published, by the joint efforts of Mr. W. N. Edwards, keeper of geology in the British Museum; Dr. J. B. Simpson, of the Geological Survey, and myself.

RECONSTRUCTION OF A FOREST SCENE

A. *The geological background*

(1) ***Prolonged and intermittent volcanic activity.*** In order to present in true perspective the scene which it is my aim to bring to life, it will be helpful to visualize the physical features of northwestern Europe some thousands of years antecedent to the phase of geological history chosen for closer examination. The chalk downs of England and part of the cliffs on the Antrim coast of Ireland are made of upraised calcareous material that was once a soft white ooze on the

floor of a clear sea, a sea which had swept slowly and irresistibly over an enormous stretch of land, embracing the greater part of England, northern Ireland and part of the region that is now western Scotland. With the uplifting of the chalky ooze from the ocean bed and the gradual recession of the waters a new land was born; a new chapter was inaugurated in the history of the earth. Following the great upheaval, as a consequential phenomenon, subterranean forces that had long been quiescent gained the upper hand: floods of semi-molten rock from deeply hidden reservoirs surged as a fiery deluge over the chalk downs, and over other and older rocks, converting thousands of square miles into barren lava-fields, extending over an area, not less than 2,000 miles from south to north, which reached far beyond the Arctic Circle. This unprecedented manifestation of volcanic energy, by no means confined to Europe and the arctic regions, but recorded on an equally titanic scale in the peninsula of India and elsewhere, is one of the wonders of geology; it is convincing evidence that the earth after the lapse of many hundred million years had not lost her youth; there was no sign of senescence. During the period we are considering most of Britain was land: we know that at a slightly later date a broad sea lay over the whole of what is now southern England. Travelers in the tube-railway in the London district may perhaps derive pleasure from the knowledge that they are being conveyed through a stiff clay upraised from the floor of that ancient sea. As an appropriate designation for the great northern land an American geologist suggested the name Thulean continent or province (see accompanying map). In the early days of the period called by geologists the Tertiary era, the greater part of the Thulean province was covered with sheets of sombre-colored lava in nearly horizontal layers, products of a series of outbursts from deep fissures rent in the earth's crust under the compelling strain of subterranean forces and from localized volcanic centers of eruption. The columnar basalts of the Giant's Causeway, the columns of the "cathedral of the sea" at Fingal's Cave, the basalts of Mull, Skye, Canna, Eigg and other western isles, weathered into step-like terraces, which form a characteristic feature of Hebridean cliffs, the flat-topped McLeod's Tables of Skye (1,600 feet), precisely similar basaltic platforms on the hills of Disko Island and the mainland of western and eastern Greenland—all these are parts of one stupendous whole, a plateau covering half a million square miles, that was once the Thulean continent. The wide-spread lava-flows represent one phase of volcanic activity in an age of exceptional unrest. Another phase is illustrated by more coarsely crystalline rocks, such as those of the dark Cuillin hills of Skye. They were not poured out as lava-streams over the land, but were forced upwards as great dome-like masses from a deeply seated subterranean source and, as their coarser texture proves, slowly cooled under the pressure of a thick superincumbent load: the comparatively large size of the crystals indicates gradual solidification from a molten mass. These two phases of prolonged rock-building help us to appreciate the immensity of geological time. Describing the lava-flows of Mull, Sir Archibald Geikie wrote: "On Ben More we can walk over each bed of basalt from the sea-level to the mountain top, a height of 3,169 feet." The basaltic lavas we see in the cliffs of Mull and many other islands are but a part of the original pile. Those that remain furnish an impressive example of rock construction which must have extended over an enormous period of time. The second phase, on the other hand, is an equally impressive example of rock destruction as a measure of geological time. We see the jagged peaks of mountains rising to a height of 3,000 feet above sea-level which, at no distant date as earth history is reckoned, were buried under a considerable thickness of younger rocks that have been utterly destroyed by the ceaseless operation of denuding agents.

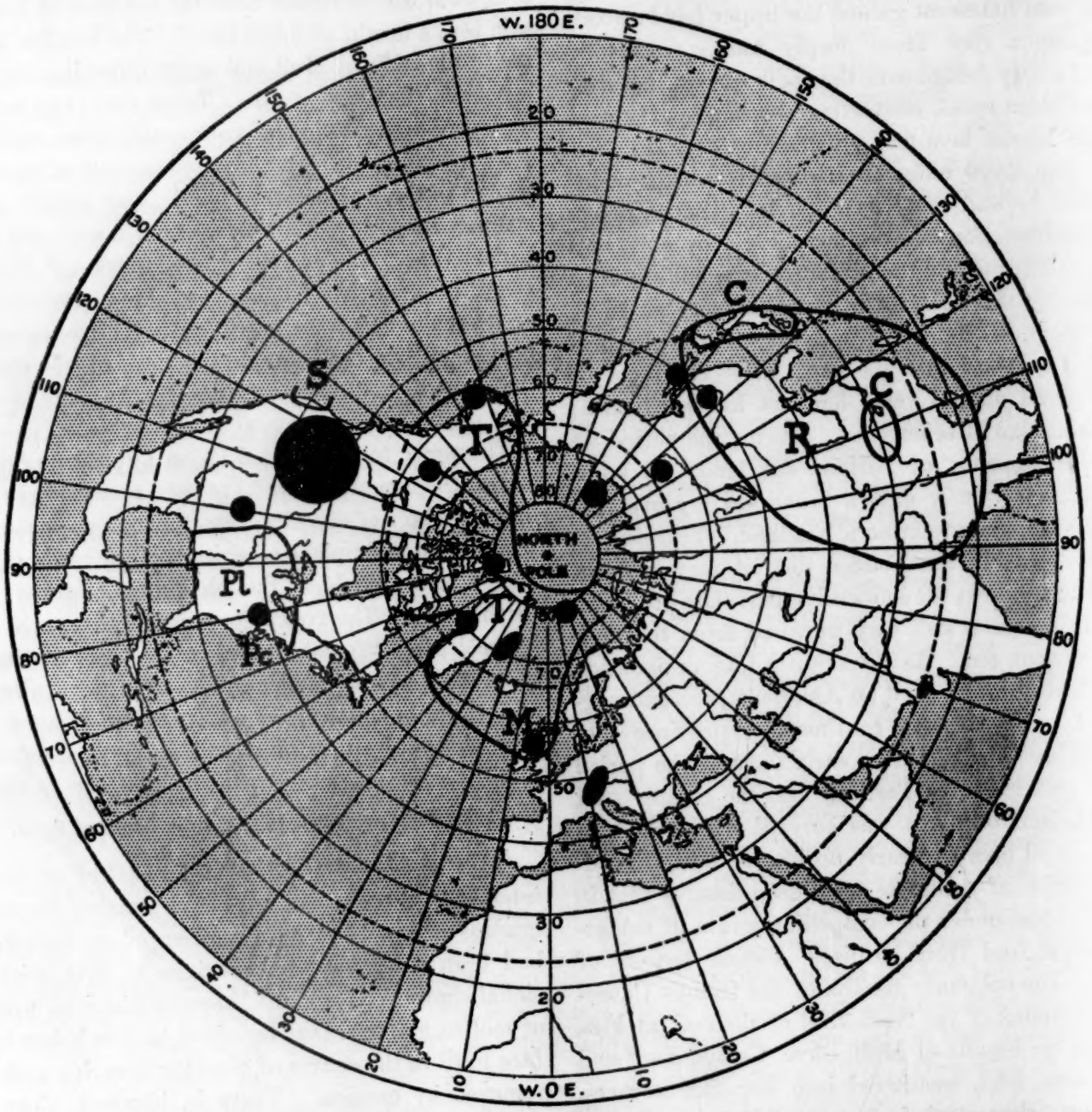
The world to our limited vision appears to be almost static; the mountains we have been accustomed to think of as symbols of eternity, seen through geological spectacles, take their place as episodes in a series of events which have moulded the changing features of the earth's face. The rocky covering of the world viewed by geologists, "foreshortened in the tract of time," reveals itself as a dynamic, mobile crust responding from age to age to constructive and destructive forces which have operated since the earth's early youth following a still earlier stage when, in the imagery of the poet,

> This world was once a fluid haze of light.

(2) *Plant-bearing sediments indicative of quiescent intervals.* So far the events chronicled in rocks of igneous origin have been spoken of as though there had been continuous outpourings of lava with occasional showers of ash and, in some districts, upwelling of molten material that remained hidden below the surface until in the course of time the covering rocks were removed by erosion. There is, however, clear proof that the extrusion of lava and other rocks was intermittent: intercalated among the lava-beds are layers of sedimentary material, hardened sand and mud, layers of coal and beds of fine-grained limestone containing beautifully preserved leaves, a few fruits and other plant fragments, also rare examples of insect wings and shells. The richest plant-containing layers occur near the base of the pile of basaltic lavas on Ardtun Head, the low "headland of the waves" near the southwestern corner of Mull, the island on which from his home on Iona—which has been aptly named "the light of the western world"—Saint Columba must often have gazed. Trees, shrubs and other plants were

able to colonize portions of the lava-field during the long pauses between recurrent outbursts of volcanic fires.

The association of sedimentary material with the basalts at Ardtun Head was noticed by Abraham Mills as long ago as 1790; but it was not until the middle of the nineteenth century that Mr. McQuarrie, of Bunessan, discovered the fossil plants, which were very briefly described by Professor Edward Forbes in an appendix to an important paper by the Duke of Argyll published by the Geological Society of London in 1851. The Duke spoke of the leaves as having been shed "autumn after autumn into the smooth still waters of some shallow lake, on whose muddy bottom they were accumulated, one above the other, fully expanded and at perfect rest." By far the richest collection of



MAP OF THE NORTHERN HEMISPHERE ILLUSTRATING SOME OF THE SUBJECTS DEALT WITH IN THE ADDRESS

C, C. The present geographical distribution of *Cercidiphyllum*, a Japanese and Chinese tree. *Black patches* mark localities and districts where fossil specimens of *Cercidiphyllum* have been found. Arctic and sub-Arctic regions: Alaska, Mackenzie River, Grinnell Land and Ellesmere Land, West and East Greenland, Spitsbergen, New Siberian Islands, Lena River. Canada and the United States of America: several localities from British Columbia and California, and east of the Rocky Mountains in Montana, Wyoming, Oklahoma, etc. The oldest examples of *Cercidiphyllum* leaves are from early Cretaceous rocks in Maryland—the Potomac formation (Pc). Others are recorded from Europe—Mull, Switzerland, Bohemia, Silesia; Eastern Asia; Sakhalin Island and the Bureja River. M. Mull and neighboring islands. Pl. The geographical distribution of the occidental plane. R. Approximate boundary of the area within which are the present homes of the majority of trees and shrubs most closely related to extinct species of the Hebridean flora. S. The present distribution of *Sequoia sempervirens* (Redwood) and *Sequoia gigantea* (Mammoth tree). T. Hypothetical boundaries of the Thulean province.

fossils was made by Mr. Starkie Gardner rather more than fifty years ago and partially described by him in a paper read to the Geological Society of London in 1887. Descriptions of several fossil plants from the Mull beds have also been published by Dr. T. Johnson. The main collection is now in the British Museum. Additional specimens have been obtained by other collectors in more recent years. The work of deciphering the botanical records from Mull, Skye and a few of the other islands is rendered mildly exciting by the danger of misinterpretation. Fossil leaves, we are often reminded, are very uncertain guides—records left by nature in a mischievous mood to mislead the unwary and over-confident student. Sir Joseph Hooker, in an address to the British Association at Norwich in 1868, spoke of fossil botany as "this most unreliable of sciences"; but he added by way of consolation—"the science has of late made sure and steady progress, and developed really grand results." One may cheerfully take the risk of being called an unscientific optimist by colleagues whose chief concern is with living plants. Botanists who confine their attention to recent plants have ample sources of information, not merely detached leaves but twigs bearing leaves, flowers and fruits. It is natural, therefore, that they should tend to underestimate the value of leaf-form and venation, characters that are often the only criteria available to the paleobotanist.

B. *The ancient flora of the Inner Hebrides*

What, then, is it possible to say about the ancient flora of the Inner Hebrides without transgressing the limits of probability? We know very little of the smaller and simpler plants which lived under the shade of the forest trees or clung to the surface of stems where they were washed by trickling rills of rain-water. The three smallest plants which have left recognizable fragments are a fungus and two liverworts or, as they are often called, hepatics, a group allied to the mosses but of simpler construction. The fungus was found by Mr. Edwards several years ago on some detached leaves of a conifer from the Mull plant-beds; the manner of its discovery illustrates an interesting technique often employed with success by students of fossil plants. In many instances leaves preserved on shale are covered with a very thin, black coaly film produced as the result of chemical change in the plant tissues after death. It is often possible, by detaching a piece of the film and treating it with certain clearing agents, to remove the carbonaceous matter and obtain a sample of the surface skin of the leaf that is brown in color, transparent and suitable for microscopical examination. After treatment the Mull leaves showed some minute dark spots on the surface film, and these on magnification were found to be circular discs made of rows of radially disposed cells. The discs were identified as organs of a fungus closely resembling reproductive structures of a living genus *Phragmothyrium*, a fungus now mainly tropical: the occurrence in Mull of a nearly allied form is, however, probably indicative of a moist rather than a tropical climate. One of the liverworts bears a close resemblance to a living species, *Pellia epiphylla*, which has a wide geographical distribution and is very common on damp earth in Britain; it has a flat green, forked body barely an inch in length. The other hepatic is a member of a different family, characterized by a slender thread-like stem bearing two rows of minute leaves; it bears a striking resemblance to some living species included in the order Jungermanniales. These two fragmentary remains of liverworts are worth mentioning because fossil examples of such plants are comparatively rare; also for another and a more important reason. A few years ago Professor J. Walton, of Glasgow, published a description of some liverworts discovered for the first time in rocks containing remains of plants which grew in the forests of the Coal Age about 200 million years ago. The interesting fact is this: the Paleozoic liverworts differ hardly at all in the construction of the delicate plant-body from the much later forms from the Thulean continent; both are essentially modern and yet both are surprisingly ancient. We do not know much about the history of these plants, but it is clear that some liverworts persisted through a succession of geological periods with practically no modification of their simple design.

The only fern so far discovered is very nearly related to the sensitive fern, *Onoclea sensibilis*, a familiar species in North America, ranging from Florida to Newfoundland and as far west as Saskatchewan; it occurs also in northern China, Manchuria, Japan and Corea; it has what is called a discontinuous geographical distribution. *Onoclea*, no longer a native of Europe, is often cultivated. The fossil fronds from Mull, both sterile and fertile, differ hardly at all from those of the living fern. Records of the rocks show that *Onoclea* formerly grew in northwestern Europe and in Greenland, regions where, through the vicissitudes of climate, it long ago failed to survive. Evidence furnished by fossils and the facts of geological history affords a clue to the present discontinuous range; in all probability *Onoclea* originated on the Thulean continent, perhaps north of the Arctic Circle, whence it spread radially into America, Europe and the Far East; in the European region it became extinct, sharing the fate of many other plants that were unable to survive the rigors of the Ice Age. Its territory was originally continuous; now it is restricted to North America and eastern Asia. Another member of the class to which the ferns belong is the familiar *Equisetum*, the horsetails: one species, closely comparable with the living *Equisetum limosum* —widely distributed in north temperate and arctic lands—has been found in the sediments of Ardtun

Head. *Equisetum* may be described as an emblem of changelessness: nearly related forms grew in Paleozoic forests at least 150 or 200 million years ago: less closely related plants in the same forests—the calamites—were comparable in size with trees. The slender horsetails of the Coal Age and their much more robust and woody allies remind us that in the course of evolution some of nature's early experiments survived unaffected by the production of new competitors, while others, less successful, left no direct descendants. As we follow the march of plant-life through the ages evidence of progress accompanied by retrogression becomes recurrently apparent: in the varying green mantle of the earth there can be traced threads running through the whole, changing very slightly as we follow them onwards and upwards, preserving all the time a remarkable uniformity in essential characters.

By far the greater number of fossils from Ardtun are leaves of trees or shrubs, which belong to one or other of the two great classes of seed-bearing plants. In Gymnosperms, including conifers and some other less familiar plants, the seeds are naked. In members of the other class, the highest, the most various and most abundant in the vegetable kingdom, the seeds are more efficiently protected and are contained in a closed case; hence the name Angiosperms. Conifers played a prominent part in the Hebridean forests, but their representatives were not such as we find in modern Europe. A single and well-preserved seed attached to a relatively large wing affords evidence of the occurrence of a conifer allied to the silver fir (*Abies pectinata*) and some other species commonly cultivated in Britain. Firs, using the term for trees belonging to the genus *Abies* and excluding the spruce fir (*Picea*), now occur in Europe, northern Africa, northern Asia and America; there is no British species of *Abies*. The Mull seed, it is important to note, agrees most closely with seeds of firs now living in China and Japan. Among other conifers discovered in the plant-beds of Mull and Skye are *Cephalotaxus, Cryptomeria* and *Sequoia*. Recent species of *Cephalotaxus* are comparatively small trees confined to the Far East; some kinds are cultivated in our gardens. The foliage of the Mull species bears a striking resemblance to that of *Cephalotaxus fortunei,* a small tree widely distributed in China. Another genus which we believe to have been a member of the Hebridean flora is *Cryptomeria;* the fossils from northern Ireland and the Isle of Skye include foliage shoots, cones and pollen-grains. The solitary living species is the Japanese *Cryptomeria japonica,* which occurs also in China—this is the tree of the famous avenue of Nikko in Japan, a notable memorial of a peasant who was too poor in worldly goods to contribute the usual building stone or a bronze lamp to the mortuary temple of an emperor, and instead offered to plant trees to protect visitors against the heat of the sun.

One of the most interesting of all living conifers is the genus *Sequoia,* of which there are two species confined within the narrow strip of hill ranges bordering Oregon and California on the Pacific coast—the Redwoods (*Sequoia sempervirens*) of the Coast Range, watered in the dry season by mists from the western ocean, and the Mammoth trees (*Sequoia gigantea,* often called *Wellingtonia*) of the Sierra Nevada (see map, S). *Sequoia* is an impressive example of the light thrown by fossil plants on the past history and wanderings over broad regions of the earth's surface of trees that, without man's protection, would be in danger of extinction. In earlier periods *Sequoia* was almost cosmopolitan; it ranged over wide spaces in the old and the new world and overstepped the limits of the northern hemisphere. Foliage shoots preserved in the sediments of Mull were in all probability borne by trees closely related to the living Redwoods, trees which are well worthy of inclusion among the wonders of the world; they attain a height of over 300 feet and the rings on cross-sections of giant trunks that have been felled bear witness to an age of 3,000 years and more. They were growing where they stand to-day 1,000 years before the Christian era. Trees next of kin to the Redwoods once lived within a short distance from the Polar Sea several hundred miles farther north than the present tree-limit. Another species of *Sequoia,* more nearly allied to the Mammoth tree, lingered on in Britain long after the disappearance of the Thulean forests: this we know from the discovery of fossil twigs and cones in the sediments of an old lake on the edge of Dartmoor in Devonshire. The two surviving species live in splendid isolation, dreaming of a greater glory that was theirs, their memories stored with secrets man can never know.

There was another naked-seeded tree in the forests into which we have intruded, a species of *Ginkgo,* the Maidenhair tree. The barbarous name *Ginkgo,* invented in 1712 by the German naturalist Kaempfer, is in the opinion of the Reverend Dr. Moule, formerly professor of Chinese at Cambridge, a false transcription of Sankyo, which probably means hill-apricot. Leaves perfect in form and venation were found in the chalky sediment of a lake that filled a hollow in the Hebridean lava-field; they differ from the foliage of the living tree only in a few minor features detected by the practiced eyes of Dr. Florin of Stockholm in the microscopical structure of the superficial cells. Dr. Simpson discovered *Ginkgo* pollen-grains at another locality. The story of the Maidenhair tree has recently been told[2] and the temptation to linger over it this evening must be resisted. *Ginkgo* of all trees furnishes

[2] *Science Progress,* January, 1938.

the most thrilling of a link with the past; its history, compiled from fossils of many geological ages and in many parts of the world, is an enthralling romance. This is but one of many histories recorded in nature's storybook which makes us share the thought of Edward Fitzgerald: "Yes, as I often think, it is not the poetical imagination but bare science that every day more and more unrolls a greater epic than the Iliad." It would be rash definitely to assert that the Maidenhair tree still exists under strictly natural conditions as a wild tree of the forest. Botanists who have searched for it in China, the country believed to be its last home, failed to discover convincing evidence of the occurrence of specimens which could not be ascribed to man's agency. On the other hand, a few years ago a Chinese botanist expressed the opinion that *Ginkgo* still grows wild in the province of Chekiang in eastern China. The oldest living examples occur in China and Japan, often in places where, as is fitting, they are venerated as trees endowed with healing properties. The history of *Ginkgo* has been traced to periods antedating by millions of years the Thulean forests. We do not know of what sort its progenitors were; but we know that it is a survival from an age too remote for us to measure in terms which we can fully appreciate. We also know that *Ginkgo,* now a lonely relic in the present world, is a primitive and isolated type, the sole representative of a large family, including many different members, all of which save the Maidenhair tree long ago fell by the way in the struggle for existence. When the tree lived in the Hebridean forests it was common in other parts of the Thulean continent from northern Canada to Greenland and Spitsbergen, in North America, Europe and Asia. It was as widely distributed geographically as oaks, pines and firs in the modern world. The history of *Ginkgo* is a record of endurance, of persistence with apparently little change in an unstable world. When we recall the amazing life-story of the tree and its forbears the autumnal color acquires a deeper significance—we see in the pale yellow of the leaves a reflection of the golden age of a family that left a precious legacy. Would that the Maidenhair tree were endowed with the oracular power of the oaks of Dodona and, in the trembling accents of its fluttering leaves, could tell us not of the future but of the varying fortunes of the family as age succeeded age.

The *Ginkgo* of Mull was not the last of its race in Europe. Well-preserved remains have been found in younger rocks in France and Germany proving that it survived in the western world, though probably only in a few places, to an age preceding by a comparatively short period the invasion of temperate Europe and North America by arctic ice-sheets and glaciers, which had a far-reaching effect upon the vegetation in the western world.

Leaving the naked-seeded plants, we pass to the flowering plants or Angiosperms. This class is more recent in origin than the Gymnosperms, at least so it would seem, and as in present-day floras so also in the Thulean forests, flowering plants contributed the greatest number of genera and species. We shall take first a few trees and shrubs which have descendants still living in Europe, and afterwards mention others that have no near relations in European floras. There were, we think, three or four kinds of oak, all different from those now living in Europe and America. The largest leaves from Mull assigned to the genus *Quercus* are oval, with a broadly rounded base and relatively small teeth; they resemble the foliage of a few Indian species, but the oak with leaves most closely resembling the fossil form is *Quercus serrata,* a native of China, the rain-forests of Assam, Japan, Corea and the Himalayas. A second species from Mull is closely comparable with other Indian and Far Eastern oaks; and a third form of leaf is very similar in shape and venation to a species that now has its home in China, Assam and the island of Formosa. It is noteworthy that none of the oaks of the Thulean forests conformed in pattern of the foliage to our familiar British trees.

One of the most conspicuous trees in the Hebridean woodland was a plane (*Platanus*) with large handsome leaves almost, but not quite, identical with those of the existing occidental plane of North America. The fossil evidence in this instance is supplied by male flowers and fruit-balls as well as leaves. As in all living planes the expanded base of the leaf-stalk enclosed and protected a bud. There is, however, one interesting feature in which the leaves of the Mull tree differ from those of any living plane: there were two fairly large leaflets attached to the long leaf-stalk between the main part of the leaf and the base of the stalk. The significance of this peculiarity need not be discussed; it is one of those botanical problems of academic interest which excite the specialist. A more important fact for us is that plane trees in the period we are considering occupied a territory which extended very much farther north than the present area of distribution. Remains of plane trees have been found as far north as Spitsbergen in rocks approximately equivalent in age to those of Mull. There are in the world to-day six or possibly eight different kinds of plane: the oriental plane (*Platanus orientalis*), the only species native in Europe, is one of the noblest living trees; it recalls the groves of the Academy in the golden age of Greece. One of the oldest specimens is the venerable stump bearing enormous arms in the market place on the island of Cos, where, legend would have us believe, Hippocrates, more than two thousand years ago, gave advice to his patients under the shade of the youthful tree. The oriental plane extends from Greece and the Aegean islands eastward to Asia Minor and the Caspian Sea; it is sometimes said to be wild in Persia

and northern India, but more probably this eastward spread should be attributed to man. The most widely distributed species in the New World is *Platanus occidentalis,* growing usually in river valleys from Lake Ontario to Florida and west to Texas and Nebraska (see map, Pl.). On the western side of North America there are other species, in Mexico and along the Coast Range hills of California. The most familiar cultivated species in Britain is *Platanus acerifolia,* the so-called London plane: this favorite urban tree is regarded by some botanists as a hybrid between the oriental and the occidental plane; the time and place of its origin are not known with any certainty. The geological record of *Platanus* affords a striking example of contrasts between past and present areas of distribution. Some of the oldest known fossil leaves and fruits are from early Cretaceous beds in Greenland, at least 300 miles north of the Arctic Circle. The occurrence of these remains in sediments that were deposited in a remote northern estuary before the chalk of the British Isles had been upraised from the sea-floor affords definite proof that plane trees lived in arctic forests millions of years before they spread to the southern part of the Thulean continent. The birthplace of *Platanus* may have been in the far north, whence in course of time it spread to Iceland and Spitsbergen, from arctic to temperate North America and Europe, and wandered as far east as Sakhalin Island on the eastern confines of Asia.

One of the comparatively few trees in the Hebridean forests related to recent British species was a *Corylus* with leaves similar to those of our hazel but still more like the foliage of species now living in India and the Far East. Hazels were associated with planes not only in the ancient flora of Mull but in circumpolar forests from which they traveled, in response to the urge of climatic change, to fresh and more genial homes farther south. Another tree in the Thulean forests was a cornel, a species of the genus *Cornus,* which has a far-flung distribution, in arctic and sub-arctic countries, in North America, Europe and Asia. While fully conscious of the danger of placing excessive trust in leaves as evidence of affinity, we believe that a Chinese cornel (*Cornus chinensis*) agrees most closely in foliage with the Mull species. The cornels are members of an old stock represented in northern forests as long ago as the Cretaceous period.

Among the larger fossils from Ardtun Head are a few almost perfectly preserved leaves of a vine, which we believe to be specifically identical with specimens previously discovered in Alaskan rocks of approximately the same geological age as those associated with the lava-flows of Mull. Similar leaves have been described from Greenland, Iceland, Spitsbergen and more southern localities in America and Europe. Vines were widely distributed even as far back as the Cretaceous period. There is now only one European species, the wine-producing *Vitis vinifera,* but its leaves are unlike the fossils from Ardtun. The striking contrast between the present distribution of the vine in Europe and its former, much more extended distribution, which included arctic and north temperate regions, raises the difficult problem of changes in climate from one age to another. Vine scrolls are a fairly common ornament on early Northumbrian Anglo-Saxon crosses, a motif adopted in still earlier ages by Greek and Roman sculptors, which, after the lapse of centuries, reached the highest expression of naturalistic treatment in England in the last two decades of the thirteenth century. Millions of years before vine leaves and fruit were fashioned in stone, one kind lived in prehuman days on the Thulean continent; and it is noteworthy that its nearest counterpart in the modern world occurs in the Far East.

We turn now to trees and shrubs belonging to genera which are no longer living in Europe. The first tree to be considered furnishes a striking contrast, in the narrow limits of its present geographical area, to the widely spread cornels and oaks. *Cercidiphyllum* is now confined to Japan and mountain valleys in some parts of China (see map, C). The name *Cercidiphyllum* was chosen because of a superficial resemblance of the leaves to those of the Judas tree, *Cercis siliquastrum.* Only a single species, with a few varieties, has survived, *Cercidiphyllum japonicum,* familiar to many tree lovers who cultivate it for the sake of the exceptionally beautiful gold, pink and red parti-colored autumnal foliage. In common with some other trees of ancient lineage, *Cercidiphyllum* lacks any near relations in the present age; it is one of a select company of nature's anachronisms. Like the Maidenhair tree, it is an aberrant type, a relic living within a comparatively small area in the Far East; formerly it was one of the most widely distributed forest trees on both sides of the Atlantic Ocean. Several beautifully preserved leaves have been found in the plant-beds of Ardtun Head, leaves and occasionally fruits of *Cercidiphyllum* have been found in Grinnell Land and Ellesmere Land on the northeastern corner of the Canadian Archipelago, in Alaska and at several localities on the Pacific and Atlantic coasts of North America, in Greenland, Iceland and Spitsbergen, as well as in Switzerland and other parts of Europe (see map). Leaves, superficially at least indistinguishable from those of the existing species, are recorded from sedimentary beds in the valley of the Potomac River in Maryland assigned to the early days of the Cretaceous period when flowering plants were comparatively few in number and had not yet come into their own as the dominant class in the plant kingdom. When we remember the remote antiquity of *Cercidiphyllum* and its wanderings over the earth's surface

during the passing of millennia, the autumnal glory of its foliage is enhanced a hundredfold and acquires a symbolic meaning.

The plant-beds on the headland of Ardtun have yielded very few recognizable fruits and seeds. Among the rare examples of fruits are some, about half an inch long, consisting of a slightly elongated seed-vessel surmounted usually by five leaflets, the enlarged and persistent covering of the young flowers, which served as efficient aids to dispersal by wind. The fossil winged fruits and associated leaves present a remarkably close resemblance to those of some living species of *Abelia,* a genus named after Mr. Clarke Abel, who discovered the shrub in China about one hundred and twenty years ago. *Abelia* is a member of the honeysuckle family (*Caprifoliaceae*); most of the existing species have their home in central China and are cultivated as flowering shrubs in European gardens. There are a few species in Japan, the Himalayas and Mexico. Fruits of a Chinese *Abelia* agree most closely with the fossil specimens. Similar though not specifically identical fruits were discovered thirteen years ago by Mrs. Clement Reid and Miss Chandler in a collection of fossil plants from Bembridge in the Isle of Wight. The Bembridge flora is younger geologically than the flora of Mull and indicates a warmer climate. Other examples were recorded long ago from southeastern France. It is therefore clear that shrubs next of kin to Abelias now living in China were once native in western and northern Europe. The introduction to British and continental gardens in our time of *Abelia, Cercidiphyllum* and other trees and flowering shrubs may be described as the reinstatement, through man's desire for horticultural novelties, of plants that had long been exiles from western woodlands where as natives they were never seen by human eyes.

So far attention has been confined to a selection of plants identified from leaves and a few fruits. If time permitted, the list could be substantially enlarged by inclusion of the interesting results of Dr. Simpson's intensive study of pollen-grains, which he found by microscopical examination of broken-up pieces of lignite and coal, associated with sandy beds in Mull and on the adjacent peninsula of Morven. The pollen-bearing layers of rock are below the basaltic lavas and therefore slightly older than the leaf-beds of Ardtun Head. Dr. Simpson discovered several conifers and flowering plants confirmatory of identifications based on leaves; he also made many additions to the list compiled from leaves, fruits and seeds. Three of his discoveries are selected for brief reference. He found pollen-grains of two kinds of alder (*Alnus*). The pollen of alders has a very characteristic structure and can easily be recognized. The occurrence of alders in the Hebridean flora supplies one of the few links between the extinct and the present European vegetation. The second genus chosen from Dr. Simpson's list is *Magnolia;* it is now represented by many species, both trees and shrubs, and is widely distributed on two sides of the Pacific Ocean—in Asia along the Himalayas and in parts of Tibet, over a large area in China, Japan and Corea, the Malay Archipelago and Indo-China; in America from southern Ontario as far south as Central America and Cuba. It was shown many years ago that *Magnolia* formerly lived in Europe and flourished as far north as latitude 70° N. in Greenland; we now know that it played a part in the adornment of the Thulean forests.

Finally a few words on the discovery of pollen-grains believed to belong to a species of *Nelumbium;* this genus is one of the most attractive water plants, a plant held sacred in ancient Egypt and venerated in the Far East. One of the living species is the sacred lotus, native in China and Japan and established as far west as the Caspian Sea; the other species has an extended range in North America, spreading as far south as the West Indies and Brazil. *Nelumbium* no longer grows in the Nile: long years ago it had a wide distribution in Europe, both in the Cretaceous period and in later ages. Looking backwards we see its great circular leaves spread over the still waters of a Thulean lake.

It is important to note that Dr. Simpson's comparative investigation of fossil and recent pollen shows a preponderance of eastern Asiatic species in the Hebridean flora.

FANCY WITH FACT

We have attempted to recreate a scene in the past, and it is natural to ask—how does our reconstruction compare with reality? As it is impossible to satisfy curiosity by an actual flight to the Thulean continent, we can at least imagine ourselves miraculously transported to a destination where the past has become the present. At a very early stage of the backward journey we should see the greater part of the land being gradually obliterated by a covering of snow and ice; glacial conditions would be succeeded by a climate becoming more and more genial. Human beings would be missed before one fiftieth of the flight had been completed. At last, after observing the moving panorama of land and sea, fluctuations in climate and changes in the character of the vegetation, let us imagine ourselves at the journey's end. Combining fact with fancy, we find ourselves, where in day-dreams we have often been, among the plants on the lava plateau. Thanks to the artistic cooperation of Mrs. Gwendy Caröe, it has been possible to give substance to our mental picture based on geological and botanical facts. It requires a special effort for us, who think of ourselves as overlords in nature's realm, to visualize a world in which man has no place. Alone in a world

which for millions of years to come would be uninhabited by the human race, we could hardly fail to look upon the beauty of nature's pageantry with a strange and more penetrating vision:

> Beauty, the eternal Spouse of the Wisdom of God
> and Angel of his Presence thru' all creation.

We should realize as never before man's insignificance: on the other hand, our estimate of spiritual values would be raised to a higher level and we should experience a deeper sense of union with the infinite. Our tendency is to think of the past, as we think of the present—in relation to man; we forget his very recent participation as an actor in life's drama. As we look at nature as into a mirror our own image obtrudes itself into the foreground. Had man been a dweller on the Thulean continent he would have seen, as we see, the sun by day setting in motion the living machinery of trees and herbs; the splendor of the evening sky; he would hear the wind in the trees, the music of running water and the songs of birds. The beauty of nature is eternal. To the east and north beyond the lava-fields the Caledonian mountain ranges would be seen rising to greater heights than any of their peaks reach to-day; they were still to be exposed for millions of years to the destructive operation of nature's sculpturing tools. Making a fresh demand upon our imagination, let us take a longer view over the curve of the earth towards the heart of Europe and far to the east to northern India. We should look in vain for the Pyrenees, the Alps, the Carpathians and the Himalayas: these and other mountain ranges had not yet been lifted up; the time of their birth was not far off. We should see in their place a broad belt of water stretching from the Atlantic to the Indian Ocean, linking West and East. On the bed of this ancient sea—the Tethys Sea of geologists—sediments had long been accumulating, and these, with other rocks of igneous origin, would be involved at no distant date in a complete transformation of the earth's features and the crumpling of the crust into the "everlasting hills."

Returning to the Thulean continent at a place near the present geographical position of the Inner Hebrides, let us take a survey of the vegetation. We should be impressed by its luxuriance: at first sight the general aspect would seem familiar, but on closer examination of the trees and shrubs we should find only a few recalling modern European species; many would remind us of exotic plants of eastern origin. Despite the immensity of the time interval separating us from the world we had left, we should not be aware of any such marked contrast in the general character of the vegetation as we might have expected. The plants had already put on their familiar dress and would seem to us surprisingly modern. But—and this would be the deepest impression—we should feel that we were among trees and shrubs that were reminiscent of remote eastern forests. We should be conscious of the dynamic character of the plant-world; we should be driven to the conclusion that the forests were mainly composed of wanderers resting for a time in a temporary home whence, as conditions changed, they would pass to other stages in the long journey to their present refuges in Asia.

Evolution

There remains another question which is always asked by those who attempt to reconstruct the vegetation of past ages: What contributions do the records of plant-life make towards a better understanding of evolution? The riddle of evolution remains a challenge and, as knowledge increases, we make fresh guesses. As a Cambridge friend writes in a recent volume of "Provocative Verse":

> That life evolves was guessed of yore,
> Darwinians prove it true;
> Of how and why we know but little more
> Than old Lucretius knew.

The little more we know urges us to continue in hopeful expectancy the long and endless prying into nature's methods. What then do we learn from the ancient flora of the Western Isles? The facts do not substantially help us to trace the unfolding of life in the long interval separating the older part of the Tertiary era from the present time. There is little difference between the past and the present vegetation of the world as a whole in the nature of trees, shrubs and ferns; our knowledge of the earlier history of herbaceous plants is very meager. The fossil flora of Mull represents an early phase of what may be called the modern type of vegetation, which overspread the world in the later stages of the Cretaceous period and has persisted with few major modifications until now. Evolution seems to have been characterized by bursts of production when new and successful types exercised a transforming influence; and these periods of exceptional creative activity were separated by periods of relative stability. The early Tertiary floras belong to a stage when a new order had become well established and an older order had passed its prime. The one great difference that emerges from comparison of the Mull flora and the existing European floras is not a difference in the components of the world forests, but a contrast in the geographical positions occupied by the various genera in the northern hemisphere: for the most part a western home has been exchanged for a home in the Far East.

Drifting Continents

If we followed the vegetation on the southern part of the Thulean land farther to the north, we should be impressed by its apparent indifference to changing

physical conditions as we traveled beyond the Arctic Circle; we should fail to notice any zonal distinguishing characters in the floras such as in our day reflect the passage from temperate to arctic regions. The evidence of fossil plants forces us to the conclusion that the vegetation on the Thulean continent, its northern boundary within a short distance of the polar sea, its southern border on the latitude of northern Ireland and western Scotland, was astonishingly uniform. How, we ask, can we explain this surprising and well-attested fact? There must, it is generally agreed, always have been climatic belts; high arctic and much lower temperate regions can not have supported closely comparable floras possessing several species in common. Some of us are convinced that changes in geography from one period to another, land connections where there are now arms of the sea, interference with paths of ocean currents and consequential changes in temperature are inadequate as explanatory causes. What then remains? Were it possible for us to make a survey of the Thulean continent as it was, we might find that the geographical relation of the northern part of the forest-clad land to the North Pole was by no means the same as it is now. It is difficult, it is probably impossible, to explain the facts without calling to our aid the hypothesis of drifting continents usually associated with the late Professor Wegener and recently discussed in an able book by Professor Du Toit, of South Africa. This is a controversial subject beyond the scope of my address. I can do little more than reaffirm adherence to the view that plant records from rocks of many ages raise problems which seem to be insoluble unless we postulate movement and sliding of the earth's crust. As icebergs are slowly drifted by ocean currents, as masses of cumulus clouds rapidly changing shape pass across a blue sky; so, the rate of travel enormously reduced, large slabs of the outermost rocky shell of the world may have shifted their position in the course of geological time. It must, however, be admitted that as yet refined methods of measurement have not furnished any evidence of crustal movement. Dr. Nörlund, of Copenhagen, has stated that longitudinal determinations, carried out by the Danish Geodetic Institute in 1927 and 1936 with a modern transit instrument, both times on the same pillar at a locality on the west coast of Greenland, gave practically the same result. In his presidential address at the Norwich meeting of the association in 1935 Professor W. W. Watts made an interesting and judicial reference to the Wegener hypothesis: he spoke of it as having been hailed by many classes of investigators as almost a panacea, and quoted one of several critics who called it a beautiful dream, the dream of a great poet.

Proof or disproof of the Wegener hypothesis will be forthcoming in the more distant future when the precision of modern methods of measurement has been available long enough to provide trustworthy data. Meanwhile we must be content to wait in sanguine expectation that an interpretation of the overwhelming evidence furnished by fossil plants will be provided by research workers in the geophysical field.

One of the most impressive examples of the bearing of fossil plants upon the fascinating problem of climatic conditions in the past has been furnished by Professor Harris, of Reading. The facts are briefly these: Several years ago Professor Nathorst, of Stockholm, described a large collection of fossil plants from rocks in Scania, the southernmost province of Sweden, demonstrating the existence of a flora many million years older than the one we have been considering. It was a very rich flora composed of numerous ferns, conifers and other plants; it probably lacked flowering plants. More recently Professor Harris made a still larger collection of fossils during a long visit to eastern Greenland in the ice-bound district of Scoresby Sound, where, under extreme arctic conditions, only a few stunted plants are able to exist. Nothing could be more striking than the present contrast between the floras of eastern Greenland and southern Sweden. The arctic fossil plants of the same age as those from Scania demonstrate the former existence of a flora even richer than that from southern Sweden; comparison of the two floras affords no indication of any difference in the size of individual plants and no difference in the vegetation as a whole. A luxuriant and uniform vegetation occupied an area stretching from central Germany to southern Sweden and a thousand miles farther north beyond latitude 70° N. The fossils preserved in rocks at localities within this far-flung geographical area from south to north give no indication of any such change in the plant communities as we should expect and as we find when we contrast arctic and temperate floras in the present world. This uniformity, I venture to think, is inexplicable unless we assume a very considerable movement and reshuffling of the earth's crust. The geological historian needs the cooperation of astronomers and physicists in his endeavor to reconstruct the world at the successive stages of its development; he looks to them to prevent him from making assumptions inconsistent with conclusions reached by workers in other fields. On the other hand, geologists and paleontologists contribute facts that are incontrovertible, however much they seem to be in opposition to the views of students whose primary interest is in geophysical problems.

Neglect of Earth History in Education

There are still some people who ask, What is the use of the kind of information given in this address? My reply is that knowledge gained from a first-hand study of nature, both animate and inanimate, has a value beyond price. Enjoyment of the romance of

creation as recorded in the life of the past and of the present is within the reach of all who have the desire to read the open pages of nature's book. In the rocks we find the soul of history: the whole world throbs with life, and the joy of it all is ours to share:

> I said it in the meadow path,
> I said it on the mountain stairs—
> The best things any mortal hath
> Are those which every mortal shares.

This evening we have caught through the mists a glimpse of a scene on earth's stage separated from the present by a small fraction of time in relation to the whole span of geological history. The Thulean forests which we have visited included trees, shrubs and other plants of surprisingly modern aspect, though it is not to be supposed that they were absolutely identical specifically with their living descendants; from the material available it is impossible to define or assess the difference. What we have seen throws little light on the evolution of the plant-world; it is equally true that the main conclusion forced upon us by our retrospect can not fail to convince us that it is impossible to understand the present distribution of plants over the earth's surface unless we extend our survey into the past. Darwin spoke of geographical distribution as a noble science, "almost the keystone of the laws of creation." The living world can not be fully appreciated as an expression of creative energy unless we free ourselves from the cramping influence of the environment in which we live.

As a botanist whose first love was geology, may I make a plea for wider recognition of physical geography and geology as branches of knowledge possessing an inestimable value as a means of bringing young people into close companionship with nature and as a source of refreshment, a stimulus and an inspiration. Most of us would probably agree with the spirit of a remark made a good many years ago by the late A. C. Benson: "I find it hard to resist the conviction that, from the educational point of view, stimulus is more important than exactness." Arguments in favor of introducing geology into schools were put forward in a "Report on Scientific Education" presented at the Dundee meeting seventy-two years ago, and in 1936 and 1937 the association published two reports on the same subject. Let me add another argument of no little value: Hugh Miller wrote in a letter to a friend, "geology is, I find, a science in which the best authorities are sometimes content to unlearn a good deal." That is worth much; geology helps us to cultivate the not too common virtue of admitting that it is possible to make a mistake. In conclusion, I can not do better than quote with whole-hearted agreement words spoken by Sir William Bragg in his presidential address to this association eleven years ago: "Some speak of modern science as tending to destroy reverence and faith. I do not know how that can be said of the student who stands daily in the presence of what seems to him to be infinite." These words apply with equal force to searchers after truth whose main interest is in the living world no less than to those whose objective is the elucidation of the structure of matter that is called by contrast dead and yet vibrates with life. The earth was once lifeless; when and how living protoplasm had its birth we do not know, nor do we know whereupon were the foundations of the earth laid. We can only echo in our hearts the voice out of the whirlwind:

> Whereupon were the foundations thereof fastened?
> Or who laid the corner stone thereof;
> When the morning stars sang together,
> And all the sons of God shouted for joy?

SCIENTIFIC EVENTS

THE FORESTS OF GREAT BRITAIN

ACCORDING to the report of the British Forestry Commission for the year ending September, 1938, approximately 54,000,000 trees were planted during the year. Forty-seven per cent. of these trees were Norway and Sitka spruces, 24 per cent. Scots and Corsican pines, 9 per cent. European and Japanese larches, 1 per cent. Douglas fir and 16 per cent. broad-leaved species. The total addition to the woodland area of Great Britain as a result of the commission's operations during the year was 20,300 acres. Including reafforestation in the former Crown woods and replanting areas damaged by fire, 24,100 acres were planted, of which 21,600 acres were planted with conifers and 2,500 acres with hardwoods.

By the end of the forest year the commissioners had 125 forests in England and Wales and 107 forests in Scotland. The total area afforested is now 365,000 acres, and is being increased by some 30,000 acres a year. During the year 92,000 acres of land were acquired, including 64,100 acres of plantable land. The commission now controls 1,100,000 acres in Great Britain. The commission mainly plants conifers, principally because the demand for coniferous timber, called softwood, is about nine times the demand for hardwood, and the commission's policy is to afforest land of little agricultural value, which is generally unsuitable for hardwoods.

The year under review was one of the worst for forest fires, which burnt 2,100 acres of planted land and cost £39,900. The worst year on record was 1929, when the damage from fire amounted to £46,000.

Railways and the general public were mainly responsible.

The number of forest workers directly employed by the commission varied between 4,555 in the summer of 1938 and 5,395 in the following winter. Further forest workers' holdings, which have an average of 11 acres each, were established, and increased the total number of holdings to nearly 1,400.

Seven eighths of the woodland in Great Britain is privately owned. A census of all those woodlands of not less than five acres was started early in 1938, and will provide reliable information on the condition and contents of the woods in view of the importance of the reserves of standing timber for national defense.

The commissioners have continued to assist planting and direct sowing by local authorities and private owners by means of grants up to £2 an acre for conifers and up to £4 an acre for hardwoods, and by a proceeds sharing scheme. So far 120,000 acres have been planted privately with the aid of grants.

Enthusiastic use has been made of the camping grounds in the Argyll National Forest Park, opened to the public by the commissioners in 1936. The number of visitors who made use of the facilities provided there was 29,500, compared with 20,400 in the previous year. Progress has been made with plans for establishing the Snowdonia and Forest of Dean National Forest Parks. The Dean National Forest Park will be opened shortly.

THE AUSTRALIAN METEORITE IN THE COLLECTION OF THE SMITHSONIAN INSTITUTION

A 2,000-POUND meteorite, probably a fragment of one of the largest to have struck the earth, has been added to the meteorite collection of the Smithsonian Institution. This specimen was found in 1903 near the town of Pearcedale, not far from Melbourne, Australia—the general area of the Cranbourne meteorite which was discovered in 1854.

The largest piece of the Cranbourne meteorite, weighing over three tons, is now in the British Museum; the second largest piece, weighing about one and a half tons, is in the Melbourne Museum. Smaller fragments are displayed in museums all over the world.

It is not known definitely whether this meteorite is actually a part of the Cranbourne fall, but according to E. P. Henderson, of the institution, it will probably prove to be so. That two separate meteoric falls of such large size would occur within such a limited area is quite improbable. The meteorite probably exploded in midair and fragments may be found some distance apart. It will shortly be placed on exhibition at the U. S. National Museum. A study will be made to determine its composition and relationships to the Cranbourne meteorite, which must be considered as one of the major collisions between the earth and a body from space. It is, however, said to be by no means the largest known meteorite.

Stony meteorites are more numerous than the iron variety, but all the largest falls, both as to size and weight, are iron meteorites. There are many scars upon the surface of the earth where meteorites have struck, notable among which is the great Meteor Crater in Arizona. The fall of 1908 which struck in northern Siberia produced a shock observed on seismographs far distant from the point of impact.

The Smithsonian has added thirty different falls to its collection so far this year. Most of these have been found in the United States. The Australian iron is by far the largest received this year, but several good-sized ones have come in from Chile and Mexico.

THE PROPOSED INTER-AMERICAN UNIVERSITY IN PUERTO RICO

SECRETARY ICKES has made public the report of the commission appointed by President Roosevelt to make recommendations for the proposed establishment of an Inter-American University consisting of six graduate schools and research units grouped about the University of Puerto Rico, of which they would be an expansion but not an integral part.

The chairman of the commission was Dr. Isaiah Bowman, president of the Johns Hopkins University. Other members were Senator Elbert D. Thomas; Frank P. Graham, president of the University of North Carolina; David L. Crawford, president of the University of Hawaii; Dean Thomas E. Benner, of the University of Illinois; Alvin Johnson, director of the New School for Social Research, New York; Victor S. Clark, economic consultant, Library of Congress; Richard Pattee, of the Division of Cultural Relations of the State Department, and Max Radin, professor of law, University of California.

Of the six special service units recommended for inclusion in the program, one already is in existence. This is a School of Tropical Medicine, the increased support and enlargement of which is recommended, as well as its merger with the proposed organization.

The other units would be a Graduate School of Tropical Agriculture, a Graduate School of Economics and Business, an Institute of Languages, Literature and History of the Americas, an Institute of Law and a Tropical Fishery Research Laboratory.

These units would form the Inter-American Institution of the University of Puerto Rico. Their control as a group by a single board independent of the university is recommended, although an interlocking relationship between this board and the board of trustees of the university is suggested.

Virtually the entire burden of building and support-

ing the proposed institution must be borne outside of Puerto Rico, which already is contributing as much as it can toward maintenance of the present university.

Operating costs are estimated at about $1,250,000 a year after the institution "gets well under way," and during the first few years there would be in addition capital expenditures for erecting and equipping essential buildings.

Responsibility for the undertaking must be assumed chiefly by the United States Government, with as much assistance as possible from private foundations and individuals and from universities throughout the Americas.

THE NEW YORK MEETING OF THE ELECTROCHEMICAL SOCIETY

THE seventy-sixth meeting of the Electrochemical Society, an international organization, will open at the Hotel Commodore, New York City, on Monday morning, September 11, and will continue through Wednesday evening, September 13.

The session on Monday morning, which is in charge of Professor Hiram S. Lukens, of the University of Pennsylvania, will be devoted to "Modern Methods in Electro Analysis." Experts in the field will describe how, with the aid of the electric current, accurate analyses can be carried out in a few minutes, as against hours consumed in ordinary chemical analysis. The Tuesday morning session on "Corrosion" is in charge of Dr. Robert B. Mears, of the Aluminum Company of America. No other subject is of more general and vital interest to both scientific men and engineers. Twelve papers will be presented covering the latest findings of research laboratories, including those of the National Bureau of Standards, the University of Cambridge, the Separator Laboratories of Stockholm, of Vienna, Berlin, Prague, Princeton, Pittsburgh and Philadelphia. The Wednesday morning session will cover electrochemical subjects of a general nature, including the electrometallurgy of lead, silver, nickel, manganese and arsenic and a paper on the cadmium-nickel storage battery.

Monday, September 11, has been set aside by the New York World's Fair as Electrochemical Day. In the afternoon Professor Bradley Stoughton, of Lehigh University, will give a popular illustrated address on "Modern Marvels of Electrometallurgy." The meeting will be held in the Science and Education Building at the World's Fair Grounds and will be open to the public. On Tuesday evening the Edward Goodrich Acheson Medal dinner will be given at the Hotel Commodore, when the Acheson Medal and $1,000 Prize will be presented to Dr. Francis Cowles Frary, director of the Research Laboratories of the Aluminum Company of America. Following the dinner and medal ceremonies there will be dancing.

LECTURES AT THE DUNDEE MEETING OF THE BRITISH ASSOCIATION

AN extensive program of lectures was arranged for the Dundee meeting of the British Association for the Advancement of Science, the inaugural general meeting of which was held on the evening of August 30, when Sir Albert Seward delivered his presidential address. This is printed in the present issue of SCIENCE.

The evening lectures, several of which already have been announced, include:

Saturday, September 2

Public lecture by Dr. M. A. H. Tincker on "Science in Gardening—Making More Plants."

Sunday, September 3

Division for the Social and International Relations of Science. Address by Sir Richard Gregory, Bt., F.R.S., chairman of the division, on "Science and Social Ethics."

Tuesday, September 5

The British and American Association Lecture, being the first lecture under the arrangement concluded in 1938, between the British and the American Associations for the Advancement of Science, by which, in alternate years, an American speaker will address the British Association and a British speaker the American Association: Dr. Isaiah Bowman, president of the Johns Hopkins University, on "Science and Social Pioneering." A public lecture, at University College, by Dr. D. A. Spencer on "Some Aspects of Color Photography," is announced for the same evening.

In addition to lectures to be given before the association in Dundee public lectures have been arranged in neighboring places. These are:

Arbreath, September 1. Professor Allan Ferguson on "Splashes and What They Teach."

Brechin, September 5. Dr. G. B. Harrison on "Color Photography."

Carnoustie, September 5. Sir Gilbert Walker, F.R.S., on "The Dynamics of Sport."

Cupar, September 1. Professor J. L. Myres on "Nomadism."

Dunfermline, September 5. Professor W. T. Gordon on "Gem Stones."

Forfar, September 5. Sir John Russell, F.R.S., on "The Comparative Value of Organic as against Inorganic Manures."

Montrose, C. W. N. Lock on "The Work of the Aerodynamics Department of the National Physical Laboratory."

Perth, September 1. Dr. C. G. Darwin, F.R.S., on "Cold Temperatures."

St. Andrews, September 1. Dr. W. T. Calman, F.R.S., on "The British Museum (Natural History)."

A lecture for school children, illustrated by zoological films, will be given by Donald Alexander on September 5.

RECENT DEATHS AND MEMORIALS

DR. ERNEST C. DICKSON, professor of public health and preventive medicine at the School of Medicine of Stanford University, San Francisco, died on August 23 at the age of fifty-eight years.

DR. MILTON A. BRIDGES, assistant professor of medicine in the New York Post-Graduate Medical School and Hospital, with which he had been associated since 1922, died on August 19 at the age of forty-five years.

DR. OTTO WOLFGANG WICHELHAUSEN, research bacteriologist in the Hospital of the Johns Hopkins University, died on August 14, at the age of thirty-five years.

PROFESSOR CHARLES PEABODY, formerly curator of European archeology at the Peabody Museum of Harvard University, died on August 17. He was in his seventy-second year.

DR. JAMES A. SHAW, director of the minerals division of the Conservation Department of Louisiana, died by suicide on August 20. Dr. Shaw was to have been a witness in the federal trial of former Governor Richard W. Leche and Seymour Weiss.

HENRY PARK HOLLIS, assistant at the Royal Observatory at Greenwich from 1881 to 1912, died on August 8 at the age of eighty-one years.

A CORRESPONDENT writes: "D. LeRoy Topping died on July 20 in Honolulu, after a long illness. He was born in North Harpersfield, N. Y., on November 2, 1861. Mr. Topping was interested in botanical field work, particularly in ferns, assembling large and important collections not only from various parts of the United States, but also in the Philippines, where he served for many years; in Siberia, where he served with the American Red Cross following the World War; in British North Borneo, particularly on Mount Kinabalu, and in the Hawaiian Islands, where he has lived since his retirement in 1922."

THE fiftieth anniversary of the death of Henry Shaw, who gave the Missouri Botanical (Shaw's) Garden and Tower Grove Park to the City of St. Louis, was commemorated on August 25, when a wreath was placed in the mausoleum at the garden where Shaw is buried. The ceremonies were conducted by Dr. George T. Moore, director. Henry Shaw was born in England and went to St. Louis in 1819. He established a hardware business from which he amassed a fortune. He died in 1889 at the age of eighty years. Mr. Shaw, after his retirement from business, established Shaw's Garden and provided for its maintenance in his will.

ACCORDING to *The New York Times*, the villa at Pontecchio, a small village near Bologna, where Marconi made his first experiments in radio transmission, has been presented by his heirs to the Guglielmo Marconi Foundation, created by Il Duce at the Royal Academy of Italy to perpetuate his memory. On the front of the house a monument will be erected. Inside relics will be preserved with documents concerning his inventions and of the technical and scientific progress derived from them. The memorial will be completed by next Marconi Day, April 25.

SCIENTIFIC NOTES AND NEWS

DR. GERALD B. WEBB, research director of the Foundation for Research in Tuberculosis at Colorado Springs, received the Trudeau Medal of the National Tuberculosis Association during the annual meeting of the society in Boston, in recognition of his attempts "to produce specific immunity against tuberculosis by the inoculation of animals with very minute numbers of tubercle bacilli."

THE Ebert Prize for pharmaceutical research of the American Pharmaceutical Association has been awarded to Dr. B. V. Christensen, director of the University of Florida School of Pharmacy, in recognition of his paper on "biological assaying" presented at the 1938 convention of the association. Dr. Christensen will become director of the Ohio State School of Pharmacy at the opening of the academic year.

DR. GUSTAV EGLOFF has been elected a fellow of the Institute of Petroleum of London.

DR. LUDWIG JOST, professor of botany in the University of Heidelberg, has been awarded the Charles R. Barnes honorary life membership of the American Society of Plant Physiology.

DR. FRIEDRICH-KARL KLEINE, honorary professor of hygiene in the University of Berlin, known for his work on tropical diseases, has been awarded the shield of nobility of the German Reich.

THE University of Edinburgh has conferred the degree of doctor of laws on Dr. G. N. Watson, professor of mathematics at the University of Birmingham.

A DINNER in honor of Dr. Roy W. Wright, professor of surgery at the Medical School of the Louisiana State University, who has been elected director of the Charity Hospital, New Orleans, was given on August 24 by his colleagues and by leaders in business and education. A desk set was presented to him by Dr. Spencer B. McNair, chairman of the dinner committee, in behalf of the hospital staff. The speakers included Dr. C. C. Bass, retiring dean of the Medical School of Tulane University, and Dr. Maxwell Lapham, dean-elect; Dr.

Paul Hebert, acting president of Louisiana State University, and Governor Long.

DR. JAMES E. RICE, professor emeritus of poultry husbandry at Cornell University, was elected president of the World's Poultry Congress, which met in Cleveland, Ohio, from July 28 to August 7. He succeeds Karl Vetter, of Berlin.

SIR HAROLD BECKWITH WHITEHOUSE, Birmingham, was chosen president of the British Medical Association at the annual meeting in Aberdeen, and Dr. Thomas Fraser was installed as president. Sir Ernest Kaye Le Fleming, Wimborne, chairman of the council for several years, was elected a vice-president. Next year's meeting will be in Birmingham.

DR. DUNCAN GRAHAM, of Toronto, was made president-elect of the Canadian Medical Association at the recent Montreal meeting; Dr. Frank S. Patch, of Montreal, was installed as president. The next meeting will be in Toronto.

AT the eighteenth annual meeting of the Jesuit Science Association of the Eastern States, held at Fordham University on August 17 and 18, the following officers were elected: *President,* the Rev. John A. Tobin, S.J., head of the department of physics at Boston College; *Secretary,* the Rev. John J. Blandin, S.J., of Loyola College, Baltimore; *Treasurer,* the Rev. Francis W. Power, S.J., associate professor of chemistry at Fordham University.

LORD BERTRAND RUSSELL, philosopher and mathematician, who lectured last year at the University of Chicago, will be a member of the faculty of the University of California at Los Angeles during the present academic year.

DR. J. W. BUTLER, of the University of Edinburgh, has arrived in the United States. He will join the department of chemistry at Princeton University at the opening of the university this month.

DR. BRUNO ROSSI has been appointed research associate in the department of physics of the University of Chicago, where he will work with Professor Arthur H. Compton. The appointment has been made possible by a grant from the Emergency Committee in Aid of Displaced Foreign Scholars. Dr. Rossi was deprived of his professorship at the new Physical Institute of Padua by the government's decrees of September, 1938. For three years he had been in charge of planning and building the new institute and equipping it for research in atomic and nuclear physics.

DR. MARGARET HESS, head of the department of biology at Judson College, Marion, Ala., has been made head of the department of biology at Winthrop College, Rock Hill, S. C.

DR. GEORGE H. REED, of the University of Illinois, has been appointed associate professor of chemistry at Knox College.

DR. J. RIGNEY D'AUNOY has presented his resignation as dean of the Medical Center of the Louisiana State University. He will remain as professor of pathology and bacteriology, but will relinquish his position as chief pathologist and medical consultant at the Charity Hospital. In accepting the resignation Dr. Paul M. Hebert, acting president of the university, wrote in part, "I wish to express the appreciation of the university for the constructive accomplishments of your administration of the medical school."

DR. WILLIAM C. BAGLEY, professor of education at Teachers College, Columbia University, became on September 1 editor of SCHOOL AND SOCIETY, a weekly journal of education. He succeeds Dr. J. McKeen Cattell, who founded the journal in 1915 and has since edited it.

DR. THEODORE T. ZUCK, a member of the staff of the Brush Foundation, Cleveland, since its establishment in 1929, has been appointed director to succeed the late Dr. T. Wingate Todd.

AT the Armour Institute of Technology, Philip Conrad Huntley, professor of mechanical engineering and head of the department, has been appointed director of the civil engineering curriculum, and James Clinton Peebles, professor of experimental engineering and director of the insulation laboratory of the Research Foundation, has been appointed acting head of the department of mechanical engineering.

DR. ROBERT STUART TIPSON, research associate of the Rockefeller Institute for Medical Research, and Warner Carlson, who held a research fellowship during the past year in the Industrial Research Foundation at the Ohio State University, have been appointed fellows of the Mellon Institute in the department of research in pure chemistry.

DR. CHARLES V. AKIN, chief quarantine officer of the Port of New York since 1936, has been detailed as assistant surgeon general of the U. S. Public Health Service in charge of the division of sanitary reports and statistics.

DR. WILLIAM MALAMUD, professor of psychiatry at the College of Medicine of the State University of Iowa, has resigned to become clinical director and director of research at the Worcester State Hospital, Massachusetts.

DR. EMIL OTT, formerly assistant professor of chemistry at the Johns Hopkins University, has been appointed director of research of the Hercules Powder Company, with headquarters in Wilmington, Del. Since 1937 he has been at the head of the research department of the experiment station of the company.

DR. BERNARD L. OSER, who directs the work of the Food Research Laboratories, Inc., of New York City, in the field of biological assaying of vitamins, has been appointed vice-president of the laboratories.

BY an order of the Committee of the British Privy Council, made after consultation with the Medical Research Council and with the president of the Royal Society, Dr. A. J. Clark, professor of materia medica in the University of Edinburgh, and Dr. T. R. Elliott, emeritus professor of medicine in the University of London and consulting physician to University College Hospital, have been appointed members of the Medical Research Council in succession to Professor H. S. Raper and Professor J. A. Ryle, who retire in rotation on September 30.

DR. ROBERT S. LIVINGSTON, associate professor of physical chemistry at the University of Minnesota, who has been working for the past year with Dr. Frank at the University of Chicago under a fellowship awarded from the Lalor Foundation, has returned from an extended European trip, during which he visited the chief centers of research in physical chemistry in England and on the continent.

DR. CHRISTOPHER H. ANDREWES, a member of the British Medical Research Council, gave a series of lectures at the Medical School of the University of Wisconsin from July 25 to 28, under the auspices of the Wisconsin Alumni Research Foundation. His subjects were: "The Nature and Properties of Viruses," "Viruses in Relation to New Growths," "Recent Work in Influenza" and "Immunity in Influenza and Other Virus Infections."

THE fifth annual meeting of the Canadian Physiological Society will be held at Queen's University, Kingston, Ontario, on Friday and Saturday, November 3 and 4.

AUSTIN WRIGHT, the general secretary of the British-American Engineering Congress, which was to have met from September 4 to 8 in New York City, reports that a cable has been received from England, announcing that British delegates have cancelled reservations to sail and that the congress will not be held. A hundred and eighty delegates from England and two hundred and fifty from Canada were expected to attend.

APPLICATIONS must be on file with the United States Civil Service Commission at Washington, D. C., for the position of associate physical oceanographer, Treasury Department, at $3,200 a year, not later than September 18. An open competitive examination to fill an existing vacancy at Woods Hole, Mass., and future vacancies that may occur in positions requiring similar qualifications will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer or promotion. Applications must also be on file on September 18 for positions with the Children's Bureau, U. S. Department of Labor, and the U. S. Public Health Service, Federal Security Agency, of psychologist with a salary of $3,800 a year; of associate psychologist, $3,200 a year, and of assistant psychologist, $2,600 a year.

THE firm of Messrs. P. Blakiston's Son and Company, Inc., specializing in scientific and medical books, has been purchased from the estate of Kenneth M. Blakiston by Horace G. White, executive vice-president of the firm. The business was established in 1843 by Presley Blakiston and was continuously in the Blakiston family until the death of Kenneth M. Blakiston in 1937. It will now be carried on under the name The Blakiston Company. Mr. White will be president of the company; Charles C. Norris, Jr., and Robert F. Bowman, vice-presidents; Edmund J. Glaser, treasurer, and Edward B. Barnes, secretary.

GROUND was broken recently for a new building for the Institute of Therapeutic Research of Merck and Company, Rahway, N. J. It is reported in *Industrial and Engineering Chemistry* that the building will be constructed of brick and concrete in a colonial design to harmonize with the research laboratory and administration buildings. It will have three stories and basement and will be 47 feet wide and 100 feet long. The entire second floor will be air-conditioned. The building will contain equipment for studies of the circulatory, nervous and respiratory systems by means of electrocardiograph, x-ray, cathode ray oscillograph, etc.; facilities for housing and feeding several thousand small animals for nutrition studies and investigation of the action of vitamins, synthetic drugs, etc.; and offices and laboratories for the staff of about twenty-eight workers.

To prevent unnecessary duplication of research and to coordinate work in the future, the paper industry has undertaken a cooperative program which will contribute to better control of sanitation in the manufacture of paper, the establishment of sanitation standards, the development of methods of analysis to accompany such standards and cooperation with health agencies. This coordinated program, to be administered through the American Paper and Pulp Association, will relate, it is hoped, investigations now in progress and suggest the trend of new experiments. The association has enlisted the Institute of Paper Chemistry to carry on the fundamental work prerequisite to the establishment of standard technics and to expand through the use of these technics the understanding of sanitary problems involved in the manufacture and conversion of paper to be used in the packaging of foods. Acting with the institute in an advisory capacity will be Dr. Fred W. Tanner, pro-

fessor of bacteriology at the University of Illinois. Dr. Tanner and the institute will work closely with a special committee of experts from the paper industry.

A CORRESPONDENT from Cannes of the London *Times* writes that at St. Michel de Provence, on the plateau of Aurifeuille, five miles from Forcalquier, a new observatory has been built which is not only the largest but the most favorably placed climatically in Europe. The site, which is at an altitude of over 2,000 feet, was decided upon after ten years of research. The 80-inch telescope at present in service at the Paris Observatory will be transported there. The observatory and the buildings attached have been designed in the Provençal style of architecture. They owe their existence to the initiative of M. Jean Perrin, who secured the financial backing while he was Under-Secretary of State for Scientific Research.

DISCUSSION

CONDITIONS AND OPPORTUNITIES AT THE NAPLES ZOOLOGICAL STATION

JUST a few years ago there were a number of American subscriptions to tables in the Stazione Zoologica di Napoli, but at the present time apparently there is only one—that of the National Research Council to which subscription was first made for the year beginning July 1, 1938. The fact that up to this time no applications for this table have been received may perhaps be attributed to distrust of conditions in Europe at the present time, or it may be that merely by chance the year has been one in which the need of American biologists for the facilities and materials of foreign stations has been at a temporary minimum. It has been thought, too, that with some persons there might be uncertainty as to the normality of operation of the laboratory. In reply to an inquiry addressed to Dr. Dohrn, director of the station, he has written, giving information that may be of interest to American biologists in general. He says:

It is quite natural that there should be some apprehension over things as they stand at present. However, during the past and the current year biologists have come to work in Naples from all parts of Europe, and, what is more, they have been able to work in an atmosphere of almost unruffled calm, and certainly one of happiness and contentment. It is therefore a great pity that this apprehension should not have been overridden. The presence here of American biologists is always a welcome addition to the body of workers with us and a most effective means for securing continued cooperative relations between biologists of our two countries.

However, it seems to me quite as possible that the fundamental trouble is lack of knowledge of the Stazione Zoologica in America, and of the facilities that it offers. Probably, too, some knowledge of the present activities of the Station would serve as a stimulus to American biologists, and to this end I am enclosing a list of the more important figures of the scientific world who have worked here during the past year, with a note appended to each of the subjects under investigation.

As to facilities it is, I suppose, natural to stress the quantity and variety of living material obtainable at Naples. Then there is the excellence of the conditions under which organisms can be kept in captivity in the Station and, no less important, the conditions under which the biologist himself may work. I am enclosing two leaflets which will perhaps do something to illustrate the extent of the apparatus and supply of reagents which are available to all. Finally we have here at Naples one of the richest biological libraries in the world for scientific periodicals, journals and abstracts; this is of eminent value to the research worker who has constantly to refer to literature relevant to his work.

I would also like to emphasize the value of foreign experience for the young American biologist, especially in reference to the contact which he can thus make with techniques and scientific ideas of European biologists, with the human element of the contact by no means the least important. As a sideline, too, I might perhaps mention the excellent opportunity for picking up a working knowledge of Italian and German, while working at Naples. Lastly, what perhaps requires no words of mine to stress is the beauty of Naples and of its environs.

You suggested very kindly in your letter to me that you could perhaps do something to give publicity to a few of the things I have mentioned about work at the Stazione Zoologica. I hope and think that this would improve the possibility of our seeing Americans working here next year, and for this reason I trust most sincerely that you can do so. If there should be any further details which you would like me to let you have, I shall be only too glad to forward them.

I cannot close this letter without thanking you once more for the special kindness and thought that you have shown to the Station, and I do most sincerely hope that we may soon return to the conditions of fruitful cooperation so valuable in the past. I shall be very thankful for anything that you can do to help bring about such a situation.

Sincerely yours,
/s/ PROF. R. DOHRN

The lists to which Dr. Dohrn refers, an extended inventory of more recently acquired biological and physical apparatus and rolls of leading investigators from many countries, predominantly British and German, engaged in work at the station in 1938 and the early part of 1939 are, of course, available for consultation in the office of the Council in Washington.

R. E. COKER

NATIONAL RESEARCH COUNCIL,
WASHINGTON, D. C.

ONE-MAN AUTHORITY CITATIONS

THE recent agitation on the subject of citation of authorities in botanical nomenclature[1] is being so prolonged that it seems advisable to review the various attacks on the existing system along the line of a comparison of the present degree of efficiency with that which might be expected from the various proposals.

Clausen's very clear reply[2] to Peattie's argument indicates that the principle of authority omission is not attractive to the practicing taxonomist. The subsequent papers by Jacot and by Baily, though agreeing with Peattie in the proposal to dispense, totally or in part, with authority citation, do not agree on the method or system to be substituted. Apparently no one is able to suggest a system sufficiently attractive to win agreement from his fellow critics of the existing method.

Dr. Samuel Johnson's oft-quoted remark is called to mind: "Every other author may aspire to praise, the lexicographer can only hope to escape reproach." The same is true of taxonomists working in any field of biology. If they are too conservative and too ready to allow variations to creep into their concept of this species or that, they are speedily made aware of the fact by the non-systematic biologist for whom they are engaged in making identifications. If, on the other hand, their species concepts are narrow and result in more numerous and less readily recognized species (no matter how sound taxonomically), they are again assailed. In short, the work of taxonomists is a service rendered to the general field of biology and as such is subject to attack from all sides, and the taxonomists must regard their productions as tools in the hands of other workers and fashion them accordingly.

On the other hand, the general field seems not to realize the urgent need in the field of taxonomy for an unfailing system of bibliographic citation, nor to appreciate the difficulties of setting in order an exceedingly complex group which has been dabbled in by a dozen taxonomists in the past two centuries and subjected to as many species concepts. (Though perhaps not in the case of this controversy, the objections to authority citation on any ground whatsoever usually have come from biologists other than taxonomists.)

Peattie (*loc. cit.*, p. 128) cited some very excellent arguments *against* his own proposal of omission of authorities, and his rebuttal of these arguments can hardly be regarded as complete. They need further examination:

(1) "The original author is deprived of credit." Of this Peattie says the purpose of authorities is not to give credit but to lead the reader to the original description. With that statement every botanist would agree; it constitutes strong argument in favor of retaining authority citations. It makes little difference to any of us if, a hundred years from now, our names remain attached to our new species and combinations, but for some reason it matters greatly whether or not those species are recognizable to the next several generations.

(2) "The one-man citation might encourage name-jugglers to attach their names to everything." Peattie points out the "remarkable activities" in this field of Kuntze and Greene in spite of two-man citation. The fact that two-man citation allows as much juggling as one-man citation is hardly an argument for the superiority of one-man citation. It is unbelievable that any botanist would fail to transfer a species from one genus to another if it obviously fit better by being changed. So long as there remain species in the wrong genera, they need to be changed, no matter whose name is attached. Actually, taxonomists are highly appreciative of the drudgery which Kuntze and Greene performed in making new combinations for the sake of accuracy.

(3) One-man citations "conceal the history of the species." Peattie wants to know "why, except in elaborate taxonomic work, should it be revealed?" It is doubtful that any biologist would admit that his work need be less accurate than that of taxonomists. If it is objectionable to a worker to reveal the history of the species he cites, he can not care much if his species names are recognizable in the next century. The history of a species often shows clearly whether one or another interpretation of the name is meant. In any study, such as host-parasite relations, ecology, physiology and genetics, in which exact identity of species and varieties is of extreme importance, complete citation of authorities facilitates subsequent identification.

The efforts of taxonomists to meet the demands of biology with a workable classification of the thousands of existing species have resulted in the building up amongst most workers of the type concept for reference purposes. That this practice is not only practical but essential is readily demonstrated in the genus *Quercus*. Even by means of modern lengthy and detailed descriptions it is in many cases quite impossible so to characterize a species that it can be recognized by subsequent workers. Linnaeus described *Quercus rubra* in the eastern United States. Du Roi misunderstood the description and applied the name to what is now known as *Q. maxima* (Marshall) Ashe. He was followed in that by numerous authors. When subsequently it was discovered that Linnaeus' name had been meant to apply to what had been known as *Q. falcata* Michaux, an attempt was made to apply the name correctly. However, so many authors were using the name to designate the more northern *Q. maxima* that

[1] SCIENCE, 88: 128, August 5, 1938; 240, September 9, 1938; 474, November 18, 1938.
[2] SCIENCE, 88: 299, September 30, 1938.

complete misunderstanding resulted, so that Professor Rehder has recently moved to abandon the name *rubra* and allow both species to carry the names subsequently proposed for them. How much difficulty and misunderstanding might have been eliminated, had there been a type specimen to help du Roi avoid his initial error, one can only guess.

No one, it is hoped, would suggest that taxonomists abandon the type system. Yet, the system would be greatly hampered by the suggested omission of one or the other of the authority citations. Full citation tells a taxonomist at a glance that at least two treatments are available, and he invariably needs to study both, unless he wishes to run the risk of perpetuating the many errors which have not yet been weeded out of botanical nomenclature. The first citation in most cases aids to fix the type. The second reveals a critical study of the species, which may or may not be accurate. To omit either would be as serious an error as the omission of a citation from the card catalogue of the Congressional Library.

Jacot (*loc. cit.*, p. 240) places undue faith in existing monographs. His suggestion that the name of the monographer giving the fullest description be cited would result in the greatest confusion. With the adoption of such a rule one could imagine every describer of a new species writing descriptions so ample that each one would cover several pages. There still remain thousands of species which have not been fully described in any monograph but were recognized beyond doubt from their original descriptions and subsequently have been changed from one genus to another. Which authority would one cite under Jacot's proposal in such a case? Jacot's notion that the old original descriptions and the authorities for them are of no practical value but only of historic value is dangerous in extreme. Ecologists, morphologists, geneticists, etc., perhaps do not realize that each of the species with which they deal is painstakingly run through the mill of "ancient" descriptions by some modern taxonomist before he dares drop it into the lap of his biological public. Only so can he be sure that he is contributing to a reasonably sound nomenclature. It is not for nothing that each succeeding International Botanical Congress has carefully revised the code of nomenclature in an effort to guide its constituent membership to greater stability.

Baily (*loc. cit.*, p. 474) charges that authority citation "augments the confusion instead of diminishing it." He cites the example of Solander's species which were published in Dillwyn's catalogue. It is easy to add numerous other examples, such as Duval's species in A. De Candolle's Prodromus. The accepted method of citation under those circumstances is "Solander in Dillwyn," "Duval in A. De Candolle" or the proper abbreviations of those names. Either method permits ready reference to the original description, particularly with the aid of Index Kewensis.

Baily recognizes the prime importance of determining the original identity of a plant name and proposes setting up a periodical to function as a receptacle for the authority citations, synonyms, etc., which so many workers wish to omit from their writings. He does not state why the Index Kewensis and the Gray Herbarium Index do not amply fill our needs, and it is not at all apparent how any other form of index could be more helpful.

It would be interesting, however, to learn how the exponents of authority omission would propose to locate in any index some of the names they might encounter. For instance, *Quercus hypoleuca* might conceivably be recommended to our nurserymen as a desirable ornamental. Without further information the nurserymen would refer to Baily's proposed periodical, where they would find *Q. hypoleuca* Engelmann credited to the American Southwest. But there is also the earlier published and quite different *Q. hypoleuca* Miquel in southern Asia. The American species is known under the present system as *Q. hypoleucoides* A. Camus. Its synonym is cited as *Q. hypoleuca* Engelmann, not Miquel. How could this information be furnished without the use of authors' names?

Even under the present system too many errors and misunderstandings arise. These certainly can not be diminished by the adoption by taxonomists of a more lax system. In fact, in the interest of an ideal of accuracy, complete authority citation (and the citation of any other information which might be helpful in subsequent identification) should be practiced by non-taxonomic botanists as well. Unfortunately, an appalling proportion of these do not even bother to collect or preserve specimens for identification.

CORNELIUS H. MULLER
BUREAU OF PLANT INDUSTRY

SPRAYING WITH PLANT GROWTH SUBSTANCES TO PREVENT APPLE FRUIT DROPPING

ORCHARDISTS need no introduction to the subject of late fruit dropping, a trouble which occurs with many apple varieties and other fruits just prior to and during harvest time and which annually results in substantial losses. For those less familiar with the problems of apple growing, for instance, it may be stated that this tendency of the fruit to drop is, in general, a characteristic of early ripening varieties, but is also of frequent occurrence with a number of important midseason and late apples. As the fruit approaches the proper maturity and color for harvesting, the danger of loss from dropping becomes more and more acute. With varieties susceptible to this trouble, each day that the fruit is allowed to remain on the tree to attain these desirable market qualities

becomes a gamble with fate. With some varieties, Stayman Winesap, for example, a disastrous drop may, without warning, occur almost overnight. On the other hand, McIntosh, a notorious dropper in many fruit sections, may fall steadily for several weeks prior to harvest time.

It is well known that climate and weather influence fruit dropping and are therefore important factors determining the feasibility of growing certain varieties in a given region. It is conceivable that elimination of the danger of dropping, in addition to safeguarding those varieties which consistently show this characteristic, may also widen the growing range of certain others, which drop badly only in the more southern regions.

Most of the commercial so-called plant growth substances have the propensity, in varying degrees, of delaying the normal abscission of various plant organs. Among a number of these substances tested naphthalene acetic acid and naphthalene acetamide have been reported[1,2,3] as being particularly effective in delaying the abscission of flowers of the date and holly, in the latter case, resulting in parthenocarpy. The frequent observance of the effect of these compounds in delaying the abscission of floral structures, stems and also of petioles on treated cuttings led to the attempt to apply them in a practical way to the problem of apple fruit dropping by spraying the trees. The results to date have been more than gratifying.

Thus far, trees of seven varieties, including Yellow Transparent, Williams Early Red, Oldenburg, Early McIntosh, Wealthy and three new early varieties, as yet unnamed, have been sprayed with various concentrations of the growth substances and a record obtained of the percentage of the total crop dropping from the trees over a period of time in comparison with the drop from untreated trees. Naphthalene acetic acid and naphthalene acetamide applied just prior to fruit maturity have proved to be particularly effective with all the varieties thus far treated. In addition to these two substances, indole acetic and indole butyric acids have been used, although the indications are that these indole compounds are much less effective in preventing abscission than either of the two naphthalene compounds.[4]

In the first experiments much stronger concentrations were used than are now proving to be necessary. Williams Early Red, as an outstanding example, was sprayed with .001 percentage of naphthalene acetic acid on July 13. By July 25 the unsprayed control trees had dropped from 64.2 to 90.8 per cent. of their total crop on actual fruit count, whereas the sprayed trees had dropped only from 1.3 to 1.5 per cent. of their fruit. Concentrations of .00025 per cent. on other varieties have since been found to bring about very marked inhibition of dropping. The effectiveness of some of these compounds in such dilute concentrations would definitely recommend their usage as a practical orchard procedure. Their practicability becomes enhanced if the present indications, that they can be added to the regular spray schedule, are borne out by additional experiments.

It is anticipated that a detailed account of the experiments will be issued in the near future when the results are compiled on additional experiments, now underway, related to various practical phases of application. This brief report, it is hoped, may serve to call to the attention of other investigators the possibility of using these compounds to advantage in the numerous problems involving the abscission of various other fruits and plant organs.

F. E. GARDNER
P. C. MARTH
L. P. BATJER

U. S. HORTICULTURAL STATION,
BUREAU OF PLANT INDUSTRY,
BELTSVILLE, MD.

[1] *Bot. Gaz.*, 99: 184–195, 1937.
[2] *Ibid.*, 100: 868–871, 1939.
[3] F. E. Gardner and P. C. Marth, *Bot. Gaz.*, 101: No. 1, 1939.
[4] Acknowledgment is made to Franklin D. Jones, of the American Chemical Paint Company, Ambler, Pa., for supplying in generous quantities all the compounds used in this work.

"DISTINCTION" IN "SCIENCE"

ACCORDING to a news item in the *Herald-Tribune* for July 19, 1939, the Postmaster General, James A. Farley, has authorized the issuance of a special series of postage stamps in honor of Americans who have "achieved fame" in the arts and sciences. The list of scientists chosen for this honor is as follows: Luther Burbank, Dr. Crawford W. Long, Dr. Walter Reed, John James Audubon and Jane Addams.

The official news release of the Postoffice Department stated that the stamps are to honor "famous Americans who have achieved outstanding distinction in the arts and sciences." "Outstanding distinction" from what source? Without intending the least disparagement of the services rendered by the Postoffice "scientists," Heaven help us if this list of names is a true index of the public's understanding and evaluation of what science is and of scientific accomplishment in the United States.

One can not help wondering who the committee was, if any, that made the selection of "scientists." Certainly it could not have been referred to either the American Association for the Advancement of Science, or the National Academy of Sciences, which is the official adviser to the Government in such matters.

C. STUART GAGER

BROOKLYN BOTANIC GARDEN,
JULY 24, 1939.

SPECIAL CORRESPONDENCE

RESEARCH IN VENEZUELA

THE activities of three previous Scarritt Expeditions of the American Museum of Natural History have previously been reported in this journal.[1] The general program of these expeditions and of the related office and laboratory work has been to contribute to knowledge of fossil mammals of North and South America and of the relationships between them. This program has been continued and broadened by recent work in Venezuela, under the direction of the writer, as were the three earlier expeditions. The Venezuelan work has been a cooperative undertaking between the American Museum of Natural History and the Venezuelan Government, through the Ministry of Fomento (development and exploitation), under the Minister, Dr. Manuel R. Egaña, that ministry defraying all field expenses and the museum paying costs of transportation and of preparation and study of materials. The museum's participation was made possible by continued sponsorship of Mr. H. S. Scarritt, of New York.

Field work in Venezuela developed into two distinct major expeditions and two reconnaissance trips. The first objective, reached in September, 1938, was the vicinity of Barquisimeto, in the State of Lara, in western Venezuela. Here Brother Nectario María, a teacher in the local Salesian school, had made several important and interesting discoveries of Pleistocene mammals. With his cooperation a camp was established about thirty miles southwest of Barquisimeto, near the village of San Miguel, and numerous fossil prospects were examined. These proved disappointing at first, but a new locality was soon found which turned out to be by far the richest deposit of fossil mammals yet known between Argentina and the United States. With the help of numerous local workmen, who proved to be unexpectedly intelligent and energetic, a large quarry was opened and this has been worked almost continuously, except for an interval of heavy rains, from October to the present time. Modern methods of extracting fragile and broken bones were employed for the first time in Venezuela, and native workmen were trained in these methods, a result which may mean even more for the future of vertebrate paleontology in Venezuela than do the collections already made.

This quarry has yielded almost innumerable bones of fossil mammals, with many jaws and at least two skulls. It is anticipated that the materials already in hand will permit the assembling and mounting of several essentially complete large skeletons. Most of the material belongs to still unidentified and probably new species of megatheres and toxodonts, with more fragmentary remains of several other groups.

[1] SCIENCE, 80: 2070, 207–208, August 31, 1934; 83: 2140, 13–14, January 3, 1936.

When the work here was well advanced and the men had become skilled in the collection of bones under these conditions, the San Miguel Quarry was left in charge of Brother Nectario, and a reconnaissance trip was made into the great llanos (plains) region south of Caracas, broad areas of which are underlain by middle and later Tertiary sediments. North of Zaraza, at a locality where the well-known geologist, Dr. Peter Christ, had already collected an important astrapothere jaw, the nearly complete carapace of a new fossil turtle was collected. With the cooperation of geologists working for the Standard Oil Company, two other promising prospects in the Miocene were located in this general region. There is every reason to hope that quarrying of these localities and more intensive search of the scattered and generally poor exposures will yield important fossil mammals, turtles and crocodiles.

A second reconnaissance, in April, 1939, was made into the higher Venezuelan Andes, as far as Mérida. In the vicinity of Valera deposits of fossil mammals, probably of late Tertiary age, were exactly located for future work. Even aside from strictly paleontological aspects, these promise to be exceptionally valuable because they are in the youngest beds definitely folded in the Andine orogeny and hence will serve to date the end of this activity.

Between these two reconnaissance trips, the writer and his wife accompanied a large Venezuelan expedition to the southern part of the country. This expedition, the Comisión Exploradora de la Gran Sabana, was one of two organized this year by the Ministry of Fomento to explore and map parts of the enormous and very poorly known Venezuelan Guayana, the great area south and east of the Orinoco, mainly inhabited by uncivilized Indians. At various times the expedition included three geologists and topographers, a mining engineer, a medical doctor, two astronomers, a soil expert, a colonization expert, an airplane pilot and a mechanic, and numerous assistants and native workmen. The writer and his wife worked with the expedition for about six weeks as naturalists. The general results of the extensive and excellent work done by this party will later be made public by its organizers and experts in other fields, and in the present note only brief mention will be made of our own results.

The first and principal base camp was established by airplane transport in Camarata, the broad open valley south of Auyantepuy, a large mountain about 300 kilometers south—southeast of Cuidad Bolívar on the Orinoco. Here, as was anticipated, no fossils of any sort were found, but during the month spent there we made collections of recent mammals and plants as well as very detailed study of the Kamarakoto Indians, a poorly known and hitherto unstudied Carib group

which preserves most of its aboriginal culture intact. From here we flew to Santa Elena, a mission station near the Brazilian border in the region of Mount Roroimá.[2] Since the Indians of this region are very, and the flora and fauna fairly well-known, we spent only about ten days here, obtaining comparative observations for the study of our Camarata materials.

During all the work in Venezuela the writer was accompanied by his wife, Dr. Anne Roe Simpson, who collected mainly recent mammals for the museum and ran our camp when we were working independently.

Except for the botanical collections, which will remain in Caracas for study and preservation, all the material collected, paleontological, mammalogical and ethnological, will be sent to New York for preparation and study, which has already begun as regards part of it. When this is completed, the collections will be divided between New York and Caracas, where they will form the nucleus of a national collection of fossil vertebrates. The results already obtained show that Venezuela is a very promising and still almost untouched field for such studies.

GEORGE GAYLORD SIMPSON
THE AMERICAN MUSEUM OF NATURAL HISTORY

SCIENTIFIC BOOKS

MALARIA IN PANAMA

Malaria in Panama. By Lieutenant Colonel J. S. SIMMONS, Medical Corps, U. S. Army with the collaboration of Lieutenant Colonel G. R. Callender, Medical Corps, U. S. Army; Major D. P. Curry, Medical Reserve Corps, U. S. Army; Lieutenant Colonel S. C. Schwartz, Medical Corps, U. S. Army, and Lieutenant Colonel R. Randall, Veterinary Corps, U. S. Army. *The American Journal of Hygiene,* Monographic Series No. 13. The Johns Hopkins Press, Baltimore, 1939. $1.10 net, postpaid.

WORKERS in public health, tropical medicine and parasitology, in general, and in malariology, in particular, welcome source books regarding malaria in any region. The present volume is particularly important because it deals with Panama, a region of outstanding importance in the development of methods of malaria control and yet one which is often misunderstood.

The book is divided into three main sections. Part 1, which deals with malaria on the Isthmus from 1501 to 1938, gives in one chapter a most interesting series of notes on the history of the disease and in another an account of the present distribution of malaria in the Republic of Panama. Part 2 is a more detailed consideration of malaria in the Canal Zone from 1904 to 1938. Its seven chapters give information of the utmost importance on various geographic features, meteorology, Health Department and vital statistics of the Zone; malaria among the canal employees; malaria carriers in the Zone, Anopheline mosquitoes, and sanitary methods used for the control of malaria in the Zone. Part 3 is concerned with malaria in the military forces on the Zone and in four chapters considers malaria among U. S. troops; distribution among the various military posts; factors concerned in the relatively high incidence of the disease among the troops, and an evaluation of methods used to control the disease among the troops.

Each chapter is a compendium of material taken from a wide variety of sources, including many official records and results of the authors' own research. Much of this material is stated in synoptic form, but at the end of most chapters a concise, readable comment is given. Finally, there is a terminal résumé in which the authors give their main conclusions in five pages. With such a mass of detail it is possible to select only a few conclusions of general interest.

According to the available data, malaria seems to have been common on the Isthmus for several centuries, and recent surveys show conclusively that the disease is widely spread in all the provinces of the Republic of Panama. This wide-spread distribution serves as a reservoir of potential infection for the sanitated regions. At the present time the sanitated areas are situated chiefly around the terminals of the Canal (including the cities of Colon and Panama in the Republic) and the locks. In these locations most of the Canal employees, military forces and their families are concentrated. Elsewhere on the Zone, where there is no anti-mosquito work or general sanitation, the employees are furnished with thoroughly screened quarters. Within the sanitated areas, the records are conclusive in showing that control measures have been effective in reducing the incidence of the disease among the employees since 1904, when Gorgas, Carter, LePrince and their associates arrived on the Zone. At the same time they also show why, even with the extensive resources at hand, it has been impossible to control the breeding of *Anopheles* in many bodies of water and why it has proved possible to sanitate only relatively small areas near the principal towns occupied by employees and around military posts. For example, Gatun Lake presents a tremendous problem, since from it mosquitoes can apparently fly into the sanitated areas at certain times of the year. This 165-square-mile lake, built as a necessary part of the high level lockage system of the Panama Canal, is relatively shallow, and vast areas of it harbor aquatic plants. These plants, especially in the dry season, are exposed in surface mats level with the water's surface and appear to be ideal breeding places for *Anopheles albimanus* and *A. albitarsis.* The former appears to be the chief malarial vector. No satisfactory means of controlling the growth of

[2] Widely, but incorrectly, publicized as Roraima.

these plants and of the mosquitoes breeding among them have, as yet, been devised. The detailed descriptions of the sanitary methods used for the control of malaria in the Zone will be of particular interest to students of malaria. Chief reliance has been placed on screening and on reducing mosquitoes by larvicides, by drainage and by filling. The situation among the troops stationed on the Canal Zone is noteworthy. Although malaria has declined among them since 1911, when they were first stationed on the Zone, the morbidity rates are higher than among the civilian employees of the Canal or among U. S. troops stationed elsewhere. Inasmuch as the barracks are located in well-sanitated areas, the authors believe the higher rate to be due to infection at night during official and unofficial visits in the Republic of Panama, in unsanitated areas of the Zone and, even to a certain extent, in sanitated areas of the Zone.

The entire book is written from the standpoint of the most up-to-date conception of malarial control and leaves little room for criticism. One disappointing feature is the untrustworthy nature of the older records—which is obviously no fault of the authors. The book, besides supplying a much needed source book on Panama, is another demonstration of the difficulty of controlling malaria in the tropics at a reasonable cost and the imperative need of further research. It is to be hoped that the various agencies carrying on research in the Republic of Panama and the Canal Zone will continue their excellent work.

W. H. TALIAFERRO

UNIVERSITY OF CHICAGO

SOCIETIES AND MEETINGS

THE NORTH CAROLINA ACADEMY OF SCIENCE

THE thirty-eighth annual meeting of the North Carolina Academy of Science was held at Wake Forest College, N. C., on May 5 and 6. About 250 members and visitors attended the meeting. Seventy-three papers and several exhibits made up the program.

The general section met the first day with the president, John W. Lasley, Jr., presiding. This meeting consisted mostly of the reading of papers of general interest and continued, except for the luncheon hour, till 4:30 P.M., when the annual business meeting was held.

At the business meeting reports of the various committees were called for. The executive committee reported the election of 33 new members and the reinstatement of 6 former members. The losses in membership were reported as follows: from non-payment of dues, 12 members; from resignation, 2 members; from death, 1 member. The committee announced the acceptance of the invitation from Davidson College to hold the thirty-ninth annual meeting at Davidson, N. C., in 1940. The committee also recommended that H. B. Arbuckle, department of chemistry, Davidson College, and W. C. Coker, department of botany, the University of North Carolina, be made life members.

The committee on high-school science reported that in the essay contest sponsored by the academy, first prize for 1939 had been awarded to Alfred Gallant, of the Central High School, Charlotte, N. C., for his essay entitled "Quartz Crystals for Radio Transmitters." The committee also reported the nomination of Ralph Kiser, Central High School, Charlotte, and Miss Eugenia Cox, Old Town High School, Winston-Salem, for junior membership in the American Association for the Advancement of Science.

In the report of the conservation committee resolutions were presented as follows: (1) that the Conservation Committee of the North Carolina Academy cooperate with the Virginia Academy "to arrange and carry out such cooperation as may be of mutual benefit to the two academies in the proposed study of the Dismal Swamp Area"; (2) that the two areas which make up the "Primeval Forest" at Highlands, N. C., be preserved and that, therefore, the U. S. Forest Service and the National Forest Reservation Commission be urged to acquire this tract immediately and add it to the Nantahala National Forest.

The committee of the American Association for the Advancement of Science research grant reported that the grant for 1939 had been awarded to F. H. McCutcheon, department of zoology, North Carolina State College, for use in his "investigation of possible experimentally induced seasonal variations in the oxygen affinity of hemoglobin in mammals."

The committee on the academy medal reported that the 1939 medal had been awarded to F. H. McCutcheon, department of zoology, North Carolina State College, for his paper entitled "The Respiratory Mechanism of the Grasshopper."

The following officers of the academy were elected for 1940: *President,* H. L. Blomquist, Duke University; *Vice-president,* John N. Couch, the University of North Carolina; *Secretary-Treasurer* (three years), Bert Cunningham, Duke University; *Member of the Executive Committee,* Earl H. Hall, Woman's College of the University of North Carolina; *Representative to the Academy Conference and the Council of the A. A. A S.,* Bert Cunningham, Duke University.

After the reading of a memorial report honoring

e late Henry van Peters Wilson, the business meeting adjourned.

At 8:30 P.M. the evening meeting was held with the ice-president, Donald B. Anderson, presiding. After brief address of welcome by Dean Bryan, of Wake orest College, President John W. Lasley, Jr., gave s retiring address entitled "The Relation between athematics and the Sciences."

On Saturday afternoon the academy met in the following sections: General, Botany, Mathematics, Physics, Zoology, The North Carolina Section of the American Chemical Society and the High School Science eachers.

The following officers were elected by the various ctions:

ZOOLOGY SECTION

airman: J. P. Givler, Woman's College, University of North Carolina.
cretary: Z. P. Metcalf, North Carolina State College.

MATHEMATICS SECTION

Chairman: T. F. Hickerson, University of North Carolina.
Secretary: J. A. Greenwood, Duke University.

PHYSICS SECTION

Chairman: H. E. Fulcher, Davidson College.
Secretary: F. W. Lancaster, North Carolina State College.

NORTH CAROLINA SECTION OF THE AMERICAN CHEMICAL SOCIETY

Chairman: E. C. Markham, University of North Carolina.
Vice-Chairman: W. E. Jordan, North Carolina State College.
Secretary-Treasurer: Ivan D. Jones, North Carolina State College.

HIGH SCHOOL SCIENCE TEACHERS

Chairman: Clifford Beck, Salisbury, N. C.
Secretary: Harry MacDonald, New Bern, N. C.

H. L. BLOMQUIST,
Secretary

SPECIAL ARTICLES

HEMICAL COMPOSITION OF THE TUMOR-PRODUCING FRACTION OF CHICKEN TUMOR I

THE agent transmitting chicken tumor I can be parated from tumor extracts quantitatively, and rtially purified, by a method of centrifugation at h speed.[1] The material prepared in this manner found to be composed of small granules, visible in dark-field microscope, approximately 70 mμ in meter,[2] with a corresponding particle weight of out 2.3×10^{-16} grams and a molecular weight of 140 millions.[3] The tumor-producing power of dinary tumor extracts varies a great deal, and only eparations exhibiting high activity were retained this study. Tests were made by injecting the shly prepared material intracutaneously in adult ns. Tumors were usually present after 8 days and final results were recorded not later than 18 days er injection. In these experiments, the smallest se to produce actively growing tumors was about 10^{-13} grams, in terms of dry weight, of the purified bstance. The relation between this weight and the ight of the individual particles indicates that the nimal active dose contained approximately 2,000 of elementary granules.

The purified tumor fraction contains 8.5 to 9.0 per t. nitrogen, a confirmation of previous analysis, and 1.5 per cent. phosphorus. Tests for proteins are positive. A typical Feulgen reaction, characteristic of thymonucleic acid, is absent. However, an intense reaction is obtained with the Schiff reagent, which suggests the presence of aldehyde groups in the material. Tests for pentoses are strongly positive.

Previous work has shown that the purified tumor fraction could be decomposed into two chief components, namely, a lipoid fraction and a protein fraction.[4] The chemical and physical properties of these fractions have been investigated further, and the results of this study is the matter of the present note.

The lipoid material associated with the tumor-producing fraction of chicken tumor I, and extracted by ether, had been found to represent about 24 to 26 per cent. of the whole substance.[4] The results of a somewhat more vigorous extraction by treating the dry substance with ether-alcohol and chloroform, at room temperature, indicates that at least 35 per cent. of the total dry weight of the purified material is lipoid in nature. This complex lipoid material contains about 2.4 per cent. phosphorus and 1.6 per cent. nitrogen.

Two main fractions can be separated from it. (*a*) One fraction is soluble in cold acetone. At room temperature it is a soft, yellow-colored mass which crystallizes in narrow plates arranged in rosettes. This fraction contains about 1.8 per cent. phosphorus and 0.9 per cent. nitrogen, figures which suggest that about half of the material may be in the form of phospholipids. The test with the Schiff reagent is negative or weakly positive. (*b*) The second fraction, which is the most abundant, has the general composition and

[1] J. C. G. Ledingham and W. E. Gye, *Lancet*, 1: 376, 5; C. R. Amies, *Jour. Path. Bact.*, 44: 141, 1937; A. ude, *Jour. Exp. Med.*, 66: 59, 1937, *Am. Jour. Cancer*, 742, 1937, and SCIENCE, 87: 467, 1938.
[2] W. J. Elford and C. H. Andrewes, *Brit. Jour. Exp. th.*, 17: 422, 1936.
[3] A. Claude, *Jour. Exp. Med.*, 66: 59, 1937; K. G. Stern d F. Duran-Reynals, SCIENCE, 89: 609, 1939.

[4] A. Claude, *Jour. Exp. Med.*, 61: 41, 1935; SCIENCE, 87: 467, 1938.

physical properties of phosphatides. It is precipitated by cold acetone and contains 3.8 per cent. phosphorus and 1.8 per cent. nitrogen, 0.3 per cent. of which is in the form of amino-nitrogen. A characteristic property of this lipoid component is that it gives a strongly positive reaction for aldehydes, when tested with the fuchsin-sulfurous acid solution of Schiff. The reaction is accelerated by acid, by heat and acid, by mercury bichloride and by trichloracetic acid. This aldehyde component of the tumor material resembles closely the substance demonstrated in the cytoplasm of certain cells, under the name of plasmalogen, by Feulgen and Voit.[5] The plasmal reaction of Feulgen, carried out on frozen sections, showed the cytoplasm of chicken tumor cells to be loaded with this lipoid.

The occurrence, in the purified chicken tumor material, of relatively large quantities of a substance which may exhibit the properties of an aldehyde is of interest, as regards tumor production, but this point is still undetermined. It is also possible that this chemically active group, which can be uncovered easily, plays a part in the so-called spontaneous inactivation of the tumor agent.

The complete lipoid fraction can be taken up in water or in salt solution, making a stable and homogeneous colloidal suspension. This is accomplished more easily under moderate heat or when traces of alcohol, which can be removed later, are present. Under the dark-field microscope this suspension appears to be composed of small particles which, as regards size and shape, are indistinguishable from those making up the original, unfractionated material. This observation suggests that the lipoid components of the purified tumor fraction may play an important role in the morphology of the active granules.

The portion of the tumor material, which is left after lipoid extraction, contains 12.6 to 13.2 per cent. nitrogen and about 1 per cent. phosphorus. Tests for protein are positive. In contrast to the complete fraction, the test with the Schiff reagent is negative, in agreement with the fact that the substances giving the reaction are removed by organic solvents. Thymonucleic acid is absent, or is not present in appreciable quantities, as shown by negative Feulgen and Dische tests. Tests for pentoses are positive. These observations support the view, stated previously, that the nucleoprotein which forms a large portion of the purified chicken tumor fraction is of the ribose type.[6]

A nucleic acid has been prepared from this material, by alkaline hydrolysis.[7] The separation is readily accomplished by leaving the freshly prepared tumor suspension in 0.1 N NaOH for 6 to 12 hours at 4° C. The alkaline mixture is then brought to pH 4.7 with 0.1 N acetic acid. The flocculent precipitate which settles at this point is removed by the centrifuge. The supernatant liquid is clear and colorless, and gives a negative biuret reaction. The Feulgen test for thymonucleic acid is negative, but tests for pentoses are strongly positive. The solution absorbs ultra-violet light in the manner of nucleic acid, with the position of the maximum at λ2575 and the minimum near λ2400.[8] The intensity of absorption of ultra-violet light and the phosphorus content suggests that 10 to 15 per cent. of the protein may be nucleic acid.

From the above nucleic acid fraction, guanylic acid was isolated by further alkaline hydrolysis. The substance gave positive tests for pentoses and the characteristic absorption spectrum of guanine.[9]

Previous studies have shown that active fractions of chicken tumor I, prepared by various methods, present a characteristic ultra-violet absorption spectrum, with a broad maximum in the region of λ2550–2575.[10] The present work is in agreement with these findings, as both the complete tumor fraction and the "nucleic acid" derived from it also show the typical maximum of absorption at $\lambda = 2575$.[8] These observations indicate, either that the substance responsible for the absorption in that region is not yeast nucleic acid, which has its maximum at λ2600,[10] or that the material contains an absorbing element which causes the maximum to be consistently displaced toward the shorter wave-lengths. The separation of a guanine nucleotide which has a broad absorption band in the region of $\lambda = 2500$, and evidence from unpublished experiments,[11] suggests that this effect might be caused by guanine as a predominating element in the molecule. A quantitative study of the various nucleotides must await the preparation of suitable quantities of material.

By the same method of differential centrifugation at high speed, it is possible to separate from normal chick embryo a fraction which, in many respects, resembles the active fraction of chicken tumor I.[12] Further analysis of this chick embryo material has emphasized the similarities between the two substances. The chick embryo material, like the tumor fraction, is found to consist essentially of a phospholipid-aldehyde portion, associated with a nucleoprotein of the ribose type.[13, 14]

ALBERT CLAUDE

ROCKEFELLER INSTITUTE,
NEW YORK, N. Y.

[5] R. Feulgen and K. Voit, *Arch. Ges. Physiol.* (*Pflügers*) 206: 389, 1924.

[6] A. Claude, SCIENCE, 87: 467, 1938.

[7] P. A. Levene and L. W. Bass, "Nucleic Acids," The Chemical Catalog Co., Inc., New York, 1931.

[8] The ultra-violet absorbing power of the solutions was determined by Dr. A. Rothen.

[9] F. F. Heyroth and J. R. Loufbourow, *Jour. Am. Chem. Soc.*, 56: 1728, 1934; T. Caspersson, *Scand. Arch. Physiol.*, 73: Supplement No. 8, 1936.

[10] A. Claude and A. Rothen, *Am. Jour. Cancer*, 26: 344, 1936; A. Claude, *Am. Jour. Cancer*, 30: 742, 1937, and SCIENCE, 87: 467, 1938.

[11] In collaboration with Dr. G. I. Lavin.

[12] A. Claude, *Proc. Soc. Exp. Biol. Med.*, 39: 398, 1938.

VITAMIN K ACTIVITY OF SYNTHETIC PHTHIOCOL

ALMQUIST and Klose[1] recently announced that pure synthetic phthiocol (2-methyl-3-hydroxy-1,4-naphthoquinone) has antihemorrhagic activity. With a sample of phthiocol, synthesized according to Anderson and Newman,[2] we were able to confirm the fact that phthiocol has some vitamin K activity.[3] Thayer *et al.*[4] have also published a confirmatory report. It is now fairly well established that a variety of naphthoquinones cure the vitamin K deficiency of chicks in a single dose of an order of magnitude of a milligram. The sample of phthiocol reported in our first communication had an activity of one unit[5] in 0.5 mg. We have since found that the vitamin K activity of phthiocol prepared according to Anderson and Newman is to a large extent due to traces of an impurity, presumably 2-methyl-1,4-naphthoquinone, which can be removed by washing its solution in alkali with ether. A sample so purified was found to have one unit in 2 mg, and is therefore only one fourth as active as the original sample. The melting point is not changed by this special purification procedure.

This is understandable in view of the unusually high potency of 2-methyl-1,4-naphthoquinone and the diacetate of the corresponding hydroquinone which serve as a starting material for the preparation of phthiocol. Since our original publication,[6] we have investigated the potency of these two compounds more extensively. The minimum effective dose is even lower than that of vitamin K_1.[7] While 2 γ of vitamin K_1 are required for a unit as used in our laboratory, the diacetate of 2-methyl-1,4-naphthohydroquinone requires 1 γ and 2-methyl-1,4-naphthoquinone only 0.5 γ. The duration of the curative effect of a single dose of 0.5 γ of the methyl-naphthoquinone dissolved in 0.1 cc of cod liver oil given to severely deficient chicks with a blood clotting time of over 90 minutes is illustrated by Table 1.

TABLE 1
DURATION OF THE CURATIVE EFFECT OF 0.5 γ OF 2-METHYL-1,4-NAPHTHOQUINONE

Chick No.	Weight gr.	Clotting time (minutes) after 6	18	48	72	96 hours
7316	60	2	1	2	5	7
7350	75	5	2	2	6	6
7366	70	3	1	2	>30	>30
7393	60	3	<½	2	4	8
7403	65	3	1	2	3	7
7414	70	6	2	2	5	>30
7430	65	3	1	2	8	>30
7449	70	2	2	2	5	>30

The activity of 2-methyl-1,4-naphthoquinone is so high that a contamination of the repurified phthiocol with 0.025 per cent. of the substance would account for the vitamin K activity. We have, therefore, submitted our phthiocol to chromatographic adsorption, using a benzene solution and calcium sulfate for adsorbent. The substance was readily adsorbed and drawn out to a homogeneous orange column on continued washing. The column was then divided into two equal parts and both parts separately eluted with ether. The activity of both fractions was equal and the same as before adsorption, showing that no fractionation had occurred. This degree of activity is probably a genuine property of phthiocol, although a biological assay of natural phthiocol would still be of interest.

A report of a successful application of phthiocol to a patient with low prothrombin time has already appeared in the literature.[8] Also 2-methyl-1,4-naphthoquinone is now being studied for its effect in raising the prothrombin content of the blood of such patients. In all of a considerable number of cases it has been found effective in a daily dosage of one milligram.

ERHARD FERNHOLZ
S. ANSBACHER
THE SQUIBB INSTITUTE FOR MEDICAL RESEARCH,
NEW BRUNSWICK, N. J.

HUMAN VACCINATION AGAINST EQUINE ENCEPHALOMYELITIS VIRUS WITH FORMOLIZED CHICK EMBRYO VACCINE[1]

THE pathogenicity of equine encephalomyelitis virus for man[2] has been proved by recognition of infections

[13] In another paper (footnote 12), a positive reaction with the Schiff reagent was erroneously referred to as a positive Feulgen test. On closer examination it was found that, as in the case of the tumor fraction, the intense reaction obtained with the fuchsin-sulfurous solution was given by the lipoid components of the chick embryo material, whereas a typical reaction for thymonucleic acid was apparently absent.

[14] The work has now been extended to a variety of other avian and mammalian tissues, especially mouse embryo and mouse tumors. By the use of the same procedure it has been possible to isolate from these tissues a fraction, likewise composed of small granules, which presents physical and chemical properties similar to those already described for chicken tumors and chick embryo fractions. The material separated and purified in the centrifuge may represent as much as 2 to 8 per cent. of the whole cellular body. These observations indicate that a phospholipid-ribose nucleoprotein complex is probably a general constituent of normal and tumor cells.

[1] H. J. Almquist and A. A. Klose, *Jour. Am. Chem. Soc.*, 1: 1611, 1939.

[2] R. J. Anderson and M. S. Newman, *Jour. Biol. Chem.*, 03: 405, 1933.

[3] S. Ansbacher and E. Fernholz, *Jour. Am. Chem. Soc.*, 1: 1924, 1939.

[4] S. A. Thayer, L. C. Cheney, S. B. Binkley, D. W. MacCorquadale and E. A. Doisy, *ibid.*, 1932.

[5] S. Ansbacher, *Jour. Nutrition*, 17: 303, 1939.

[6] S. Ansbacher and E. Fernholz, *loc. cit.*

[7] S. A. Thayer, L. C. Cheney, S. B. Binkley, D. W. MacCorquadale and E. A. Doisy, *loc. cit.*

[8] H. P. Smith, S. E. Ziffren, C. A. Owen and G. R. Hoffman, *Jour. Am. Med. Assoc.*, 113: 383, 1939.

[1] This work was supported by a grant from Lederle Laboratories, Pearl River, N. Y.

[2] K. F. Meyer, *Ann. Int. Med.*, 6: 645, 1932.

with the virus under natural conditions[3] and following laboratory contact with virus-diseased chick embryo tissues.[4,5] The occurrence of unrecognized infection in man has been demonstrated,[5] and in a recent study[6] of the incidence of such subclinical infections we have examined 184 human sera,[7] 69 of which were from individuals exposed to the Eastern strain virus. In 23 of these 69 sera antibodies sufficient to neutralize 100 to 1,000 infective doses of virus were found, and in one instance the serum fixed complement in the presence of Eastern strain virus purified by ultracentrifugation. Similar though less definite results were obtained in parallel studies with the Western strain. These findings have introduced the problem of protective vaccination, especially in workers frequently exposed to virus-diseased tissues and animals. We have vaccinated a group of men and women with formolized chick embryo vaccine[8] and have studied the probable effectiveness of the procedure by the examination of their sera for the presence of neutralizing antibodies.

Injections were made with a "bivalent" vaccine, prepared in the routine way for the immunization of horses. Vaccines consisting of 40 per cent. suspensions of diseased chick embryo tissue formolized to 0.4 per cent. were prepared separately for the Eastern strain and Western strain viruses. These were centrifuged at low speed, mixed in equal parts and used without further treatment. Two injections were made with an interval of 7 days. In some instances 1.0 cc was given as the first dose and 2.0 cc for the second. The majority, however, received two doses of 2.0 cc each. Routine injections were made deep in the gluteal muscles in two areas to lessen reactions to the formalin. Injections into the deltoid muscles of three individuals caused painful local reactions. Blood was drawn prior to the first vaccination and after 7, 14 and 21 days.

Slight general reactions were observed in a few of 89 volunteers vaccinated. Sharp transient pain was experienced locally in most instances, followed occasionally by low-grade dull pain for from one to three days.

Sera from 23 of those vaccinated have been tested[9] for neutralizing antibodies against the Eastern strain virus, and a typical protocol is shown in Table 1. In 9 of the 23, serum taken 7 days after the first injection seemed to protect mice. In every case after 14 days, antibodies nearly as effective as those after 21 days were observed. After the latter interval the antibody content was sufficiently great to neutralize completely 100 to 1,000 infectious units of virus, except in one individual, whose serum neutralized only 10 units. In one instance, the serum drawn 21 days after a single injection of 1.0 cc vaccine protected against 1,000 infectious units.

TABLE 1

MOUSE PROTECTION TESTS AGAINST EQUINE ENCEPHALOMYELITIS VIRUS (EASTERN STRAIN) WITH SERUM OF WOMAN VACCINATED WITH FORMOLIZED CHICK EMBRYO VACCINE

Case	Serum	Date bled	Date vaccinated	Amount vaccine	Number of deaths in 4 injected mice				
					Virus dilution				
					10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}
L. H.	a (control)	May 2	May 2	1.0 cc	4	3	2	2	0
	b	May 9	May 9	2.0 cc	4	4	3	1	0
	c	May 16			1	1	0	0	0
	d	May 23			0	0	0	0	0

The crude bivalent vaccine was thus found to be effective in the induction of antibodies against the Eastern strain virus, and to cause little discomfort. Vaccines containing less formalin and chick tissue debris may prove as effective and more useful for human vaccination.[10]

J. W. BEARD
DOROTHY BEARD
HAROLD FINKELSTEIN
DUKE UNIVERSITY SCHOOL OF MEDICINE

[3] L. D. Fothergill, J. H. Dingle, S. Farber and M. L. Connerley, *New England Jour. Med.*, 219: 411, 1938.
[4] R. R. Case, personal communication, Dr. R. W. G. Wyckoff.
[5] P. K. Olitsky and I. M. Morgan, *Proc. Soc. Exp. Biol. and Med.*, 41: 212, 1939.
[6] H. Finkelstein, D. Beard and J. W. Beard. Unpublished work.
[7] Obtained through the generous cooperation of members of the staff of Lederle Laboratories, Pearl River, N. Y., and Sharp and Dohme Company, Philadelphia, Pa.
[8] J. W. Beard, H. Finkelstein, W. C. Sealy and R. W. G. Wyckoff, SCIENCE, 87: 490, 1938.
[9] P. K. Olitsky and I. M. Morgan, *loc. cit.*
[10] R. W. G. Wyckoff, SCIENCE, 89: 542, 1939.

BOOKS RECEIVED

BIGGER, JOSEPH W. ***Man Against Microbe.*** Pp. 304. 17 figures. 18 plates. Macmillan. $2.50.

HARRISON, GEORGE R. ***Massachusetts Institute of Technology Wavelength Tables, with Intensities in Arc, Spark, or Discharge Tube.*** Pp. xxviii + 429. Wiley. $15.00.

SCHEINFELD, AMRAM and MORTON D. SCHWEITZER. *You and Heredity.* Pp. xvii + 434. Ilustrated. Stokes. $3.00.

TINKLE, WILLIAM J. ***Fundamentals of Zoology.*** Pp. xvi + 492. 278 figures. Zondervan, Grand Rapids, Mich. $3.00.

TRELOAR, ALAN E. ***Elements of Statistical Reasoning.*** Pp. xi + 261. 47 figures. Wiley. $3.25.

WEEKS, MARY E. ***Discovery of the Elements.*** Pp. v + 470. Illustrated. Journal of Chemical Education, Easton, Pa. $3.00.